INSTRUCTION MANUAL
MODEL 1751TC-3204B

California INSTRUMENTS

Invertron® AC POWER EQUIPMENT

MP MASTER
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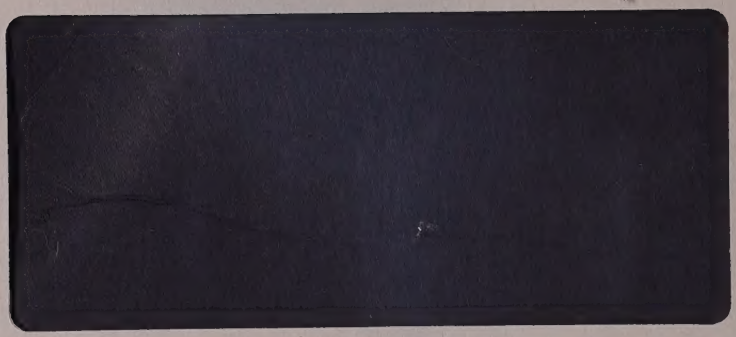

California INSTRUMENTS

Revision C
January, 1989

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INSTRUCTION MANUAL
MODEL 1751TC-3204B

Invertron®

MANUAL ERRATA

Model 1751TC-3204B AC Power Source

The Model 1751TC-3204B is a modified version of the Model 1751TC-3204A for improved performance. The improvement is associated with the specification for AC Noise Level.

Drawings and schematics in this instruction manual have been revised to Model 1751TC-3204B revision levels.

Make the following changes in this instruction manual:

1) Replace "1751TC-3204" with "1751TC-3204B".

2) Page 7:

AC NOISE LEVEL:	65dB below full output with input shorted.
*OUTPUT VARIATION DUE TO AC LINE MODULATION:	60dB below rated full output at no load with output voltage at 300 VAC rms. (Equivalent to 800 millivolts peak-to-peak variation).
	55 dB below rated full output at rated output power with output voltage at 300 VAC rms. (Equivalent to 1500 millivolts peak-to-peak variation.)
*PEAK TRANSIENT	49 dB below full output, worst case, with output voltage at 300 VAC at rated output power. (Equivalent to 1500 millivolts peak variation.)

*These two specifications have been added for clarification of the improvement in the AC NOISE LEVEL specification.

CAUTION

THE MODEL 1751TC-3204B MUST ONLY BE USED WITH CALIFORNIA INSTRUMENTS MODEL 848TCM-3205D AC POWER CONTROLLER.

CAUTION

MODELS 848TCM-3205, 848TCM-3205A, 848TCM-3205B AND 848TCM-3205C ARE NOT TO BE USED WITH THE MODEL 1751TC-3204, MODEL 1751TC-3204A OR MODEL 1751TC-3204B.

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LIST OF DRAWINGS

ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
None	4150-902	OUTLINE DRAWING 1751TC-3204 (page 12)
	4150-442	TOP ASSEMBLY
	4150-444	FRONT PANEL ASSEMBLY
	4150-443	REAR PANEL ASSEMBLY
	4150-445	RECTIFIER/FILTER ASSEMBLY
	4150-440	MODULE ASSEMBLY HEATSINK, NEGATIVE
	4150-441	MODULE ASSEMBLY HEATSINK, POSITIVE
	4150-439	SUPPORT ASSEMBLY, HEATSINK
	4150-099	SCHEMATIC, TOP ASSEMBLY
A1	4150-717	PC ASSEMBLY, PREAMPLIFIER
	4150-098	SCHEMATIC, PREAMPLIFIER

REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
A2	4995-726	PC ASSEMBLY, METER DRIVE
	4995-611	SCHEMATIC, METER DRIVE
A10 & A17	4150-715	HEATSINK ASSEMBLY, DRIVER POSITIVE
	4150-716	HEATSINK ASSEMBLY, DRIVER NEGATIVE
	4150-097	SCHEMATIC, DRIVER HEATSINK
A11 & A12	4150-714	HEATSINK ASSEMBLY PARALLEL POSITIVE
A15 & A16	4150-714	HEATSINK ASSEMBLE PARALLEL NEGATIVE
	4150-096	SCHEMATIC, PARALLEL HEATSINK
A7	4995-725	PC ASSEMBLY,CURRENT LIMIT INTERFACE
	4995-610	SCHEMATIC, CURRENT LIMIT INTERFACE

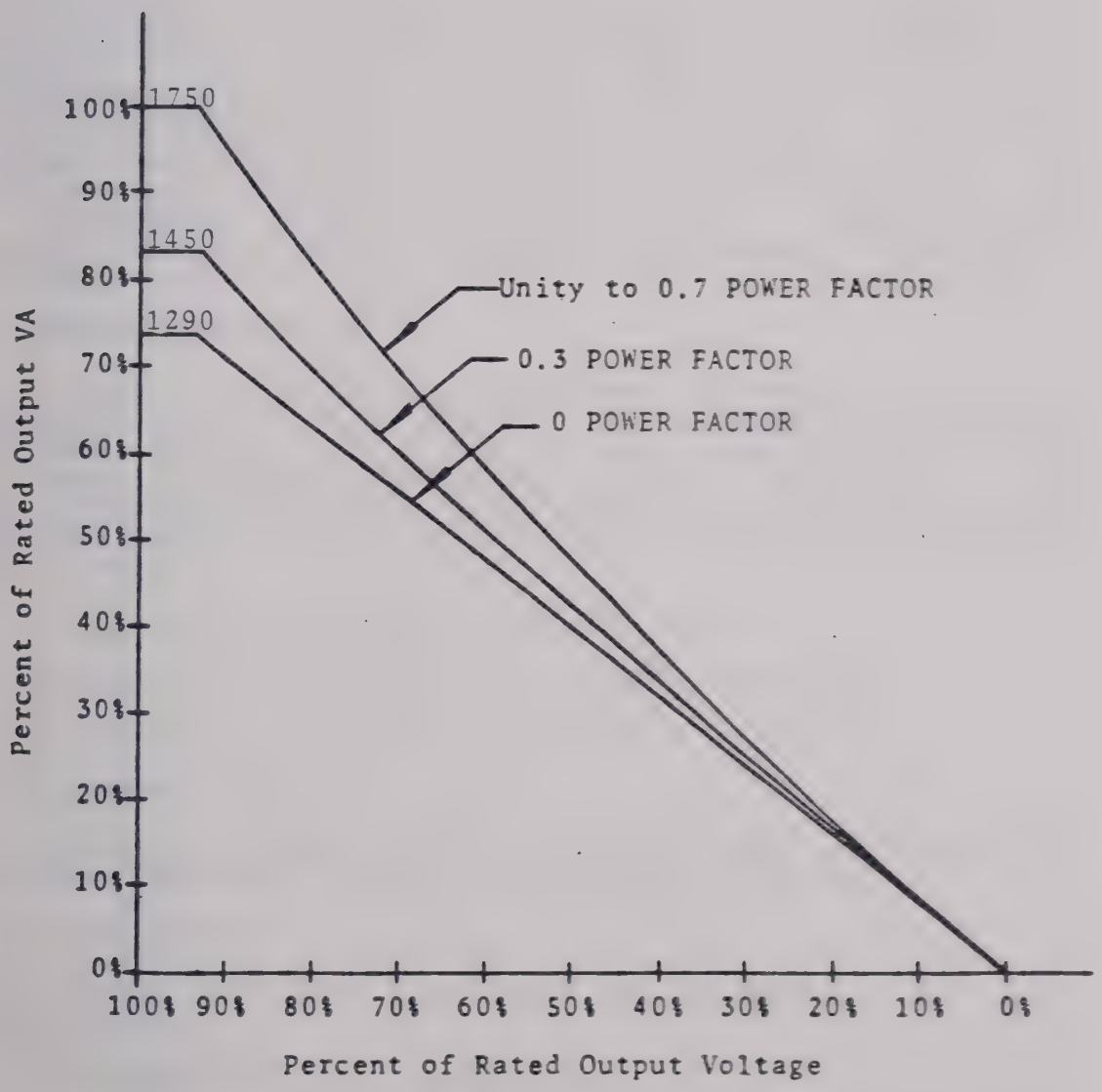
SPECIFICATIONS
MODEL 1751TC-3204 AC POWER SOURCE

All of the following specifications are tested in accordance with standard California Instruments test procedures. Tests must be made with a stable, low distortion input signal as generated by the 848TCM-3205 plug-in AC Power Controller.

POWER OUTPUTS:	1750 VA at 70 to 75V rms on the 0-75V range 1750 VA at 140 to 150V rms on the 0-150V range 1750 VA at 280 to 300V rms on the 0-300V range All ranges from unity to 0.7 lead or lag power factor. See derating chart for operation at other output voltages and/or power factors.
OUTPUT VOLTAGE RANGES:	0 to 75 volts rms 0 to 150 volts rms 0 to 300 volts rms
TOTAL HARMONIC DISTORTION:	Less than 1.0% distortion from 45 Hz to 5.6 KHz.
AMPLITUDE STABILITY:	±0.25% for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION:	When tested at unity power factor: ±3.33% over the range from 45 Hz to 2 KHz. ±4.67% over the range from 2 KHz to 5.6 KHz.
LINE REGULATION:	±0.25% of full output for a ±10% line change.
FULL POWER FREQUENCY RANGE:	45 Hz to 5.6 KHz.
FREQUENCY RESPONSE:	±0.5 dB from 45 Hz to 5.6 KHz.
AC NOISE LEVEL:	65 dB below full output with input shorted. 40 dB below full output at full rated power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuits is provided. Automatic reset occurs when overload is removed.

AMPLIFIER DRIVE REQUIREMENTS: (Normally obtained from plug-in)	5 volts rms (maximum) produces full scale output voltage with GAIN control in the full clock-wise position.
AC INPUT LINE:	3Ø 208 volts rms ±10%
AC INPUT FREQUENCY:	47 to 63 Hz.
AC INPUT POWER:	5000 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 50 degrees Centigrade.
FRONT PANEL METER:	0 to 300 volt AC voltmeter provides ±1% of full scale accuracy at 400 Hz and ±3% of full scale accuracy over the range from 45 Hz to 5.6 KHz.
DIMENSIONS:	Height 14.0" Width 19.0" Depth 22.0"
NET WEIGHT:	220 pounds
SHIPPING WEIGHT:	250 pounds
FRONT PANEL FINISH:	Gray, 26440 per Federal Standard 595 with black silk-screened lettering.

The derating chart applies over the range from 45 Hz to 5.6 KHz



POWER DERATING CHART FOR MODEL 1751TC-3204 POWER SOURCE

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information for the installation, operation, calibration and maintenance of the California Instruments Model 1751TC-3204 Power Source. Detailed schematics, parts location drawings, calibration procedures and theory of operation are also included to aid maintenance personnel.

Section I contains a brief description of the Power Amplifier and its accessories. Section II provides safety precautions, procedures for the initial installation, and operating procedures. Section III provides a concept of how the power amplifier operates, and a detailed description of the circuits. Section IV contains the calibration procedures. Section V provides maintenance and troubleshooting information. The circuit diagrams are contained in Section VI. Section VII lists the replaceable parts and information for ordering them. Appendix A contains the code list of manufacturers. Appendix B provides the program to run the 24 Hour Amplitude Stability Test.

1.2 GENERAL DESCRIPTION

The California Instruments Model 1751TC-3204 Power Source is a high-reliability, high performance, low distortion power amplifier that provides up to 1750 VA output when used with the California Instruments 848TCM-3205 AC Power Controller. Full power output is available in three different voltage ranges and over the frequency range from 45 Hz to 5.6 KHz. These full power voltage ranges are:

1. 70 to 75 volts rms in the 0-75V range.

2. 140 to 150 volts rms in the 0-150V range.

3. 280 to 300 volts rms in the 0-300V range.

1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 1751TC-3204 Power Source.

1.3.1 Rack Slides

Tapped holes have been provided on the bottom panel for rack slide mounting.

1.3.2 AC Power Controller Extender Board

The AC Power Controller extender board extends the plug-in power controller beyond the front panel for maintenance of the Model 848TCM-3205 AC Power Controller.

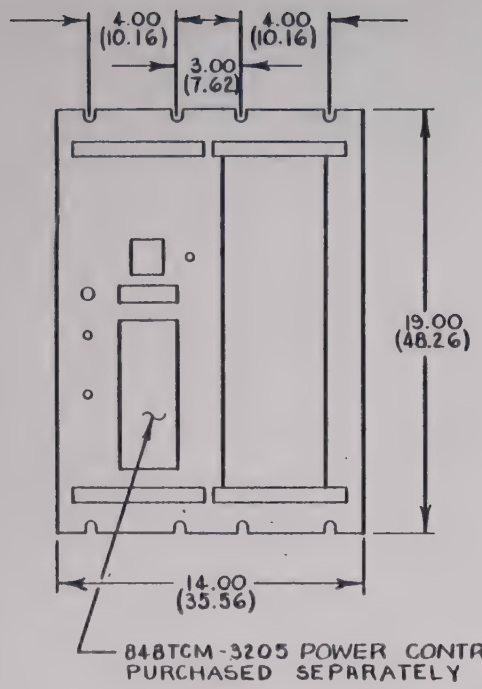
1.3.3 4848-406 Test Fixture

The 4848-406 Test Fixture is inserted in place of the plug-in power controller for troubleshooting, validation, and calibration of the Model 1751TC-3204 Power Source.

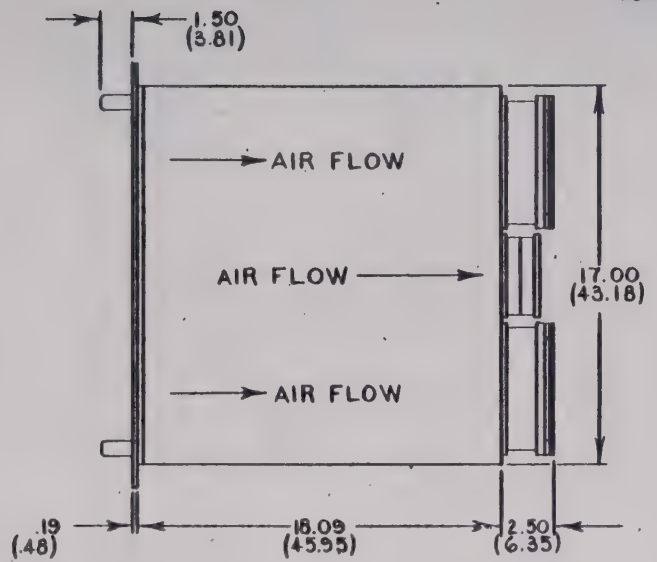
1.3.4 848TCM-3205 Programmable AC Power Controller

The 848TCM-3205 Programmable AC Power Controller is a low-power, high-reliability unit that programs and monitors the voltage, frequency and phase angle required from the 1751TC-3204 Power Source. The power controller can be programmed using the keypad on its front panel or by a remote computer over the IEEE-488 GPIB. Confidence testing of the 1751TC-3204 Power Source is performed by the power controller which then reports any problems to the remote computer.

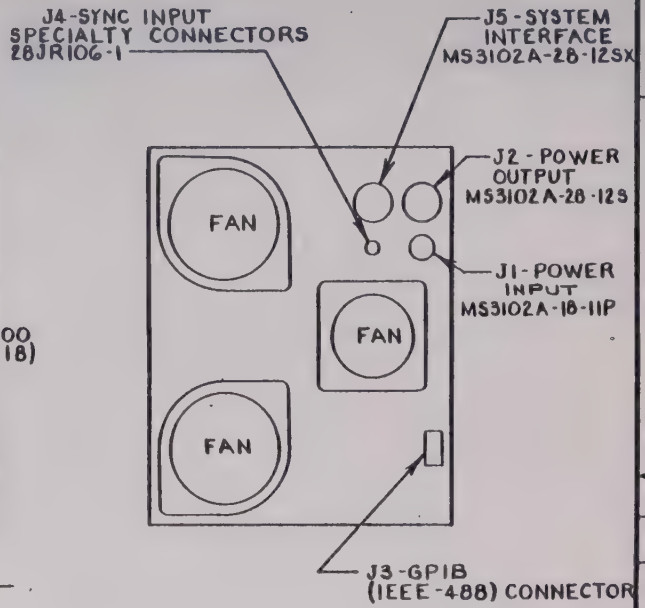
REV	DESCRIPTION	DATE	APPROVED
A	J1 FROM OUTPUT TO INPUT	3-29-84	DWE



FRONT VIEW



TOP VIEW



REAR VIEW

2. DIMENSIONS SHOWN IN PARENTHESIS ARE IN CENTIMETERS.
1. FRONT PANEL DIMENSIONS PER E.I.A STANDARD RS-310.

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
REF	1751TC-3204	4150-442-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO.

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES

DWG SIZE C

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FINISH

TITLE
OUTLINE DRAWING
1751TC-3204

			ADDITIONAL APPROVALS
RELEASE	R Belgard	4/19/84	
PROJ ENG	R Belgard	4/1/84	
CHECK			
DESIGN			
DRAFT	R.GERVAIS	4-16-84	Kunde 4/15/84

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO., INC
SAN DIEGO, CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO 4150-902
REV A
SCALE 1/4
SHEET 1 OF 1

4150-902 A

CAUTION

HIGH VOLTAGE (300 VAC)

Voltages up to 300 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits and the output circuits of the power source.

SECTION II

INSTALLATION AND OPERATION

2.1 SHIPPING CONTAINER

The California Instruments Model 1751TC-3204 Power Source is shipped in a cardboard container which is stapped to a wooden pallet. The container has protective inner foam spacing blocks. Do not destroy the packing container or pallet until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

2.2.1 AC Line Voltage Input Connections

The Model 1751TC-3204 Power Source has been designed to operate from 3Ø 208 volts rms ±10%.

2.2.2 Line Frequency Operating Range

This Model 1751TC-3204 has been designed to operate over the AC line frequency range of 47 to 63 Hz.

2.2.3 Normal Input Power

The normal input power, at rated output, is between 3700 and 4200 watts depending on line and load conditions. During "turn-on" the peak transient may exceed 80 amps during the first AC cycle.

2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 1751TC-3204 Power Source uses a three pole 15 ampere Heinemann AM3-A3-A-15-3 circuit breaker for operation from the 208 volt AC line. Substitution of circuit breaker type or current rating may cause permanent damage to the unit.

2.4 OUTPUT VOLTAGE RANGE

The output voltage range is determined by a set of range relays (K1 and K2) which are controlled by the Model 848TCM-3205 AC Power Controller via J10 which is the AC Power Controller interface connector. Table 2-1 lists the control signal states in reference to connector J10. The appropriate output range may be set during acceptance tests by using the output range selection switch located on the face of the 4848-406 Test Fixture.

Table 2-1 External Voltage Range Control

"R1A" J10 PIN 5	"R2A" J10 PIN D	RESULTING OUTPUT VOLTAGE
High	High	300 volts
Low	High	75 volts (default)
High	Low	150 volts
Low	Low	75 volts

NOTE: low = signal ground
high = +5 volts DC or no connection (open)

2.5 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following:

2.5.1 Initial Setup

CAUTION

If the front panel GAIN control on the Model 1751TC-3204 has been set and "locked" for systems applications, do not change the setting of this control.

1. Connect the Model 1751TC-3204 and associated test equipment as shown in Figure 4-4.
2. Set the external oscillator output frequency to 400 Hz and output amplitude to zero volts.
3. Set the 3Ø 5KW autotransformer output to 208 VAC line-to-line ±10%.
4. Set the Output Range control switch on the 4848-406 Test Fixture to 150 VAC.
5. Set the Current Limit switch on the 4848-406 Test Fixture to "OFF".
6. Verify all switches on the 1750 VA load are in the "OFF" or open position. (See Figure 4-3.)

2.5.2 Power ON

1. Apply input power to the 1751TC-3204 by setting the front panel circuit breaker to the "ON" position.

2. Verify that the input power does not exceed 500 watts on the power monitor.

3. Advance the amplitude control on the external oscillator until the power source output is 140 VAC as monitored on the DMM. (Approximately 7 VAC from external oscillator).

4. Verify that the output wave shape is a clean, undistorted sine wave on the oscilloscope.

2.5.3 Load Test

1. Close "S1" on the 1750 VA Load Assembly.

2. Verify that the output wave shape remains a clean undistorted sine wave on the oscilloscope.

3. Verify that the output voltage changes less than 1% on the DMM when "S1" is closed.

4. Verify that the output distortion is less than 1% on the distortion analyzer.

2.5.4 Overload

1. While monitoring the oscilloscope display close "S2" on the 1750 VA Load Assembly.

2. The signal on the oscilloscope should exhibit significant clipping on both the positive and negative peaks.

CAUTION

If the overload is applied to the output of the 1751TC-3204 more than 10 to 15 seconds, the front panel circuit breaker may trip.

3. Open "S2" on the 1750 VA Load Assembly and verify that the output wave shape returns to a sine wave.

2.5.5 Extended Testing

1. Section 2.5.1 thru 2.5.4 may be repeated for any output frequency between 45 Hz and 5.6 KHz.

2. Section 2.5.1 thru 2.5.4 may be repeated on either the 300 VAC range or the 75 VAC output range. See Table 2-2 for voltage and load values.

TABLE 2-2 OUTPUT RANGE VOLTAGE AND LOAD VALUES

Range	Output Voltage	R1 100% load	R2 50% overload
300 VAC	280 VAC	44.8 ohms	89.6 ohms
150 VAC	140 VAC	11.2 ohms	22.4 ohms
75 VAC	70 VAC	2.8 ohms	5.6 ohms

3. The Calibration Procedure in Section IV of this manual should be used if more detailed evaluation of the Model 1751TC-3204 is required.

2.6 MECHANICAL INSTALLATION

The Model 1751TC-3204 Power Source has been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-rack. (paragraph 1.3.1).

The cooling fans on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 2.5 inch clearance should be maintained between the rear of the fans and the rear door of the mounting cabinet. The air intake on the front of the power source must not be obstructed.

2.7 INPUT POWER WIRING

The Model 1751TC-3204 Power Source must be operated from a three phase input voltage of 208 VAC ±10%. The power source should be used with 208 volt line-to-line AC power lines with a capacity of 15 amperes or greater per phase.

2.8 OUTPUT POWER WIRING

The power output wires should be large enough to avoid excessive line voltage drops. Table 2-3 lists the minimum acceptable wire size for a 1.0 percent line drop assuming a 1750 VA output at a distance of 20 feet from the power source to the load.

Table 2-3 Output Wiring Requirements

OUTPUT VOLTAGE RANGE	MAXIMUM LINE DROP	LOAD CURRENT	LOOP LENGTH	MINIMUM REQUIRED WIRE SIZE
75 volts	.75 volts	23.3 amperes	40 feet	2x #12
300 volts	3 volts	5.83 amperes	40 feet	#20

NOTE

The wire size should be reduced 3 sizes everytime the distance between the power source and load is doubled.

2.9 FRONT PANEL CONTROLS

2.9.1 Circuit Breaker

The three pole circuit breaker, located on the front panel of the Model 1751TC-3204 Power Source, is used to turn the power source ON and OFF. When the unit is energized, the amber indicator lamp located above the circuit breaker will glow.

2.9.2 GAIN Control

The GAIN control is used to adjust the output voltage level of the power source. The amplitude of the output of the system is controlled by the 848TCM-3205 Power Controller. The typical GAIN control setting will provide 100% output voltage with a 7.04 VAC oscillator input.

2.9.3 Voltage Meter

The front panel meter has a full scale range of 300 volts. It will measure the output voltage of the power source to an accuracy of ±1% of full scale at 400 Hz and ±3% of full scale from 45 Hz to 5.6 KHz.

2.9.4 EXCESSIVE LOAD Indicator Lamp

The front panel EXCESSIVE LOAD lamp is activated when the power source output current exceeds the maximum rated output current. The lamp turns off immediately upon removal of the overload.

2.9.5 THERMAL OVERLOAD Indicator Lamp

The THERMAL OVERLOAD lamp is activated when the heatsink temperature exceeds a safe value. While the lamp is on, the power source output is reduced to essentially zero. When the

power source cools to a safe temperature the THERMAL OVERLOAD lamp turns off and resets the power source to normal operation automatically.

2.9.6 REG Control

The REG control (R2) is used to vary the output impedance of the power source. It is normally factory set at 400 Hz which provides a zero output impedance with a 100% load. The REG control is recessed into the front panel and can be adjusted using a narrow-bladed screw driver.

2.10 OPERATION OVER EXTENDED FREQUENCY RANGE

The Model 1751TC-3204 Power Source must not be driven at signal frequencies below 45 Hz or above 7.0 KHz, otherwise permanent damage to the unit may occur.

SECTION III

THEORY OF OPERATION

3.1 GENERAL

The California Instruments Model 1751TC-3204 Power Source is a high-reliability 1750 VA amplifier and with the 848TCM-3205 AC Power Controller is designed to provide reliable sine wave AC power over the frequency range from 45 Hz to 5.6 KHz.

A block diagram for the amplifier is shown in Figure 3-1. Filter FP-LP is a lowpass filter that prohibits damage to the power source caused by accidental application of input frequencies above 7 KHz. Opto coupler A1U2 and associated drive circuitry disables the preamplifier input signal during a power supply fault condition or a thermal overload condition. The preamplifier (G1,G2) is used to amplify the input signal to supply adequate drive to the power amplifier (G3).

The power amplifier (G3) provides the necessary sine wave signal to drive the output transformer T2. The output transformer has floating secondary windings which allow the load to float from the amplifier and AC Power Controller circuitry.

The power amplifier (G3) contains the overload and short circuit protection circuitry. A local negative feedback signal is taken from the output of the G2 amplifier back to the input of the G2 amplifier.

The overall negative feedback is taken from the primary winding of T2 back to the non-inverting input of the preamplifier and provides a closed loop gain of 5.3 from the arm of potentiometer R1 to the primary of T2.

The four 75 volt secondary windings of T2 are connected in parallel for the 0 to 75 volt output, series-parallel for the 0 to 150 volt output, and in series for the 0 to 300 volt output. All of the transformer output ranges are selected using relays K1 and K2.

The positive voltage feedback loop provides a signal proportional to the load current and is used to compensate for losses. Tertiary winding terminals 3 and 4 of T2 are used to buck out the L di/dt drop of the primary. The remaining signal is proportional to the IR drop in the power primary and is fed back in phase with the oscillator signal. The degree of positive feedback is set with R2.

Power transformer, T1, along with the associated rectifiers and filters, supply the operating voltages for the AC Power Controller, the preamplfier (G1,G2) and the power amplifier (G3).

The rated VA output of the power source is, to a large extent, determined by the power dissipation in the quasi-complementary symmetry output stage. The power dissipation is determined by

the power factor of the load, the output VA level of the amplifier, and by the actual output voltage expressed as a percentage of the rated output voltage. The derating chart, in the specifications at the front of the manual, expresses this derating in a graphical form.

When the power source is delivering its full rated output voltage, the output transformer T2 has 26.5 volts rms across the primary.

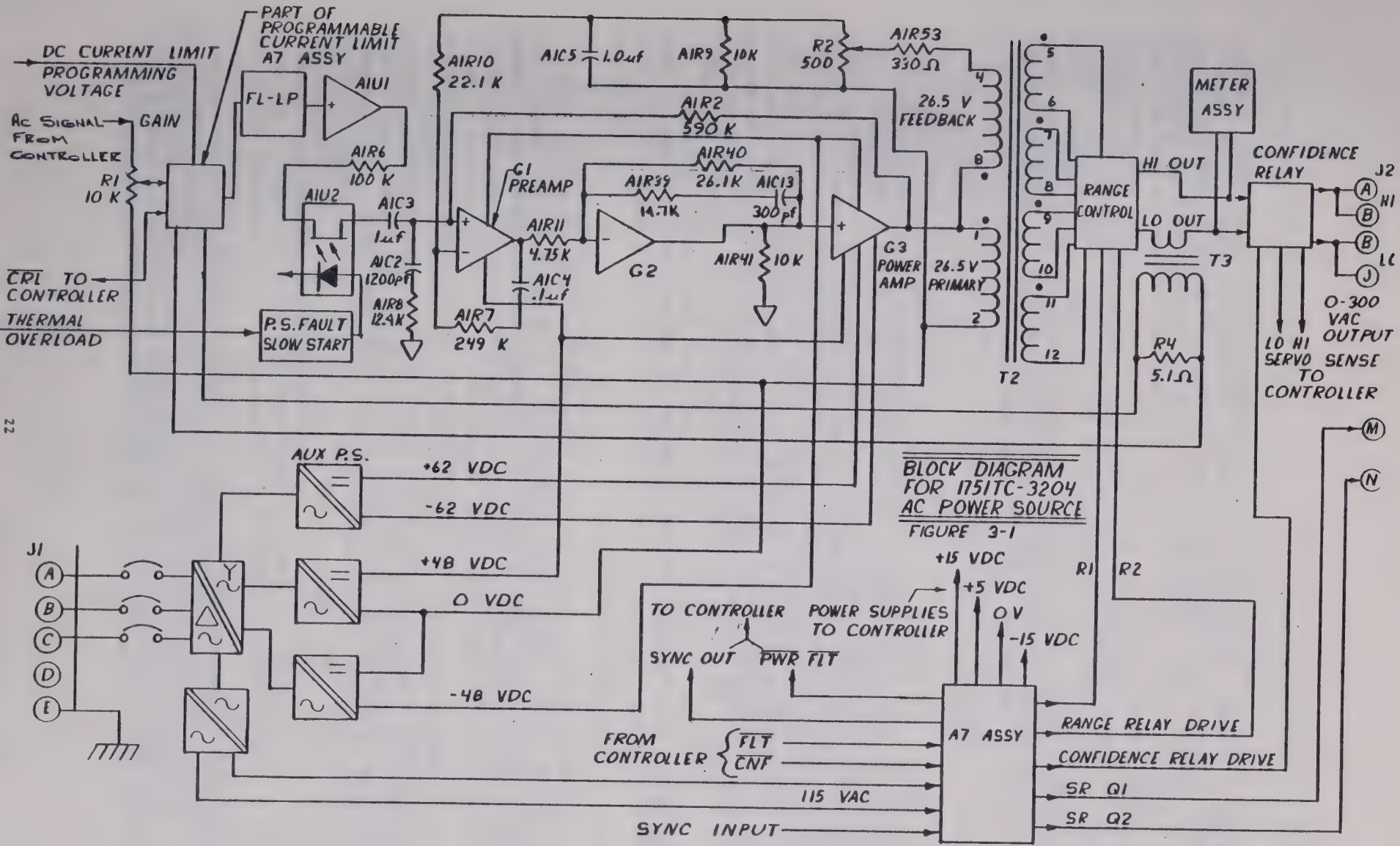
3.2 DETAILED CIRCUIT DESCRIPTION

A chassis level schematic diagram for the Model 1751TC-3204 Power Source is shown in drawing 4150-099. All components, not mounted directly on the chassis assembly, are designated as parts of a circuit board assembly. Table 3-1 lists the circuit board assemblies by their designators.

Table 3-1 Circuit Board Listing

DESIGNATOR	ASSEMBLY #	SCHEMATIC	NAME
A1	4150-717-1	4150-098	Preamplifier Assy
A2	4995-726-1	4995-611	Meter Board Assy
A7	4995-725-3	4995-610	Current Limit Interface Assy
A10	4150-715-1	4150-097	Positive Heatsink Driver
A11	4150-714-2	4150-096	Postive Parallel Heatsink
A12	4150-714-2	4150-096	Positive Parellel Heatsink
A15	4150-714-1	4150-096	Negative Parallel Heatsink
A16	4150-714-1	4150-096	Negative Parallel Heatsink
A17	4150-716-1	4150-097	Negative Heatsink Driver

All other components are a part of the top assembly. For information on the plug-in power controller, consult the 848TCM-3205 AC Power Controller manual. The drawings include typical voltage levels for the various sections of the power source.


DC CURRENT LIMIT PROGRAMMING VOLTAGE
PART OF PROGRAMMABLE CURRENT LIMIT A7 ASSY
AC SIGNAL FROM CONTROLLER
GAIN
R1 10 K
FL-LP
A1U1
A1R6 100 K
A1U2
A1C3 1uf
A1C2 1200pf
A1R8 12.4K
P.S. FAULT SLOW START
CRL TO CONTROLLER
THERMAL OVERLOAD
A1R10 22.1 K
A1C5 1.0uf
A1R9 10K
R2 500
A1R53 330Ω
A1R2 590 K
26.5 V FEEDBACK
A1R40
A1R39 14.7K
A1C13 300 pf
G1 PREAMP
A1R11 4.75K
A1C4 .1uf
A1R7 249 K
G2
A1R41 10 K
G3 POWER AMP
26.5 V PRIMARY
T2
RANGE CONTROL
HI OUT
LO OUT
T3
R4 5.1Ω
METER ASSY
CONFIDENCE RELAY
J2
HI
LO
0-300 VAC OUTPUT
LO HI SERVO SENSE TO CONTROLLER
AUX P.S.
+62 VDC
-62 VDC
+48 VDC
0 VDC
-48 VDC
J1
A
B
C
D
E
BLOCK DIAGRAM FOR 1751TC-3204 AC POWER SOURCE
FIGURE 3-1
+15 VDC
+5 VDC
0 V
-15 VDC
R1
R2
TO CONTROLLER
POWER SUPPLIES TO CONTROLLER
SYNC OUT
PWR FLT
FROM CONTROLLER
FLT
CNF
115 VAC
SYNC INPUT
A7 ASSY
RANGE RELAY DRIVE
CONFIDENCE RELAY DRIVE
SR Q1
SR Q2
M
N

3.2.1 INPUT FILTER

Input filter FL-LP on the block diagram is a two pole active lowpass filter made up of one-half of A1U1 and associated components. The 6 Db point of this filter is set at 30 KHz by the values of R3, R5, C11 and C12. This filter is used to prohibit the application of high frequency noise or signals to the preamp and power amp.

3.2.2 BUFFER AMP

Buffering of the input signal between the input filter and the fault circuitry is provided by one-half of A1U1. This half of A1U1 is configured as a unity gain voltage follower.

3.2.3 FAULT CIRCUIT

Additional amplifier protection is provided by A1U2 and its associated drive circuitry. A1U2 is normally in the full "ON" mode (less than 200 ohms). The ±48 volt supplies in the unit are monitored by A1VR2 which is a programmable zener diode. The programmed set point is established by R35 and R36 such that the differential voltage between the buses must exceed 83.5 volts to enable the preamp via A1U2. A1VR1, A1Q10 and A1Q9 provide isolation and level shifting between the fault sensing circuit and A1U2. The programmalbe zener fault sensing circuit may also be activated by the thermal overload switches in the drive heatsinks via A1CR8. A1Q9 and associated components also provide a "soft start" feature. This "soft start" allows the output voltage of the unit to ramp up to its programmed value when a fault is removed.

3.2.4 PREAMPLIFIER (G1 G2)

The preamplifier is the primary interface between the AC power controller and the power amplifier. Its main functions are voltage gain, DC level shifting and stability compensation. The primary active element of G1 is OP amp A1U3. The gain for this stage is set by A1R7 and A1R10 at 22 dB.

G2 provides in excess of 68 dB of open loop gain in addition to level shifting. A1Q1 and A1Q4 provide DC level shifting while A1Q2 and A1Q5 provide voltage gain. A1Q3 and A1Q6 provide current gain to isolate the gain stage from the load. The closed loop gain is set at 14.8 dB by the ratio of A1R40 to A1R11. The dominant pole for this stage is set at 13 KHz by components A1R40, A1R39, and A1C13. A small amount of additional phase margin in the overall loop is achieved with A1R39 which introduces a zero at approximately 35 Khz.

Overall compensation of the unit is provided via A1C2, A1R8, A1R2 and A1R6. The closed loop gain for the entire unit is set at 15.4 dB by A1R2 and A1R6. The dominant pole is set at 1.5 KHz by A1R2 paralleled with A1R6 in conjunction with A1C2. A zero is provided at 10.5 KHz by A1R8 and A1C2 to improve the overall

phase margin of the unit.

3.2.5 POWER AMPLIFIER (G3)

The power amplifier G3 consists of heatsink assemblies A10, A11, A12, A15, A16 and A17.

The positive polarity of the power amplifier is A10, A11 and A12. Electrically the positive polarity power amplifier is made up of A10Q1 thru A10Q9, A11Q1 thru A11Q11 and A12Q1 thru A12Q11 with their associated components. All transistors in the postive power amplifier are connected in the emitter follower configuration to provide the necessary current gain to drive the primary of the output transformer. These transistors supply a total of 100 amperes peak during the positive half cycle of the output waveform when the power source is loaded to 1750 VA output power at 93.3% of rated output voltage.

The negative polarity power amplifier consists of A15, A16 and A17 heatsink assemblies. Electrically the negative polarity power amplifier consists of A15Q1 thru A15Q11, A16Q1 thru A16Q11 and A17Q1 thru A17Q9 with their associated components. The transistors in the negative power amplifier are connected in the quasi-PNP configuration. The negative polarity power amplifier provides the necessary current gain to supply 100 amperes peak current to drive the primary of the output transformer when the power source is loaded to 1750 VA output at 93.3% of rated output voltage.

The primary of the output transformer has a 26.5 volt rms signal when the power source is delivering its full rated output voltage.

3.2.6 OUTPUT RANGE SELECTION

The range relay decoding is performed by inverters in A7U7. These drive the relay drivers in A7U6 which drive the range control relays. Resistors A7R7 and A7R8 limit the current to the range relay coils. Paragraph 2.4 and Table 2-1 provide additional information on the range relays.

Relay common (A7J1-9) is not used as an active signal to control the relay drivers in A7U6. It is tied to the internal ground terminal E2 to isolate the relay ground return current from the signal circuits.

3.2.7 OVERLOAD PROTECTION

Overload protection from momentary overloads and shorts is provided by current limit transistors A1Q7 and A1Q8. The positive current limit circuit acts to clamp the base drive to A10Q1 through transistor A1Q8. The load current through A10R6 is sensed and the voltage drop is applied to divider network of A1R43, A1R25, A1R26 and A1R27 and is used to turn on the current limit transistor. The threshold of the current limit action is

set by A1R43.

The current limit circuit for the negative heatsink functions in the same manner using A1R42 to set the threshold.

The rated VA of the power source is dependent upon the power dissipation in the Class AB output stages. Reference to the derating chart page 9, should be made when operating the power source at less than 93.3% of rated output voltage, or power factors less than 0.7.

3.2.8 OVERALL NEGATIVE FEEDBACK

The overall negative feedback loop is a single-ended operational feedback loop taken from the primary winding of T2 back to the non-inverting input of A1U3 through resistor A1R2. This feedback network limits the midband closed loop voltage gain of the amplifier to 5.3 from the arm of potentiometer R1 ("GAIN") to the primary of T2.

This overall feedback loop provides approximately 25 dB of negative feedback over the range from 45 Hz to 5.6 KHz. The purpose of this feedback loop is to ensure that the frequency response, distortion, gain and amplitude stability specifications are met and/or exceeded.

3.2.9 POSITIVE VOLTAGE FEEDBACK

The positive voltage feedback loop provides a signal proportional to the load current and is used to compensate for losses. Tertiary winding terminals 3 and 4 are used to buck out the L di/dt drop of the primary. The remaining signal is proportional to the IR drop in the power primary and is fed back in phase with the power controller signal. The degree of positive feedback is set with R2 and will provide a minimum of five percent of full scale compensation.

3.2.10 PROGRAMMABLE CURRENT LIMIT FUNCTION

The Programmable Current Limit function includes some components that are not mounted on the A7 assembly. The 848TCM-3205 Controller provides a 0.976 to 9.76 VDC signal to A7J2-15 which programs the Current Limit value from 10% to 100% of full load output current.

The power source output current is sensed by current transformer T3. Full load current (25 amperes) is scaled to equal 1.0 VAC across burden resistors R4 and R5. This current sense voltage is rectified by A7U8, A7CR8, A7CR7 and A7U9.

The programming current limit value at input A7J2-15 is scaled for the appropriate output voltage range by an Analog Multiplexer A7U14. A7U9 serves as a buffer amplifier for the scaled programmed output of A7U14. The rectified current sense voltage is compared to the output of A7U9 by integrator A7U13, C7 and

scaling resistor network A7Z2.

During normal operation the programmed Current Limit value exceeds the power source output current and the output of A7U13 is held to -.6 VDC. The photo modulator A7U12 is saturated full on approximating a short circuit between the 848TCM-3205 Controller signal (A7J2-14) and the preamplifier input (A7J2-8).

When the power source output current exceeds the programmed limit value, the output of integrator A7U13 increases. This causes photo modulator A7U12 to turn off until its increasing resistance has attenuated the preamplifier input to a level that reduces the power source output current to the programmed value.

When the current limit circuitry becomes active the $\overline{\text{CRL}}$ signal at A7J2-11 is set to a digital low state by A7U3 and A7Q2.

3.2.11 EXTERNAL SYNC FUNCTION

The external sync signal circuit includes transformer A7T2 which isolates the 26 VAC signal (400 Hz). This signal is converted to a square wave by comparator A7U10 and inverted by A7U3 to provide the $\overline{\text{EXT SYNC}}$ signal.

3.2.12 CONFIDENCE RELAYS

Confidence relay K5 provides 115 VAC to an external contactor coil which energizes to connect the output of the Model 1751TC-3204 to the user's load. The coil of K5 is driven by the confidence signal from A7 via transistor A1Q11 and associated components on the A1 preamp assembly.

Confidence relays K3 and K4 select the servo feedback lines to the Model 848TCM-3205 Controller. These servo feedback lines are connected to the sense points at the user's load in the normal operating mode or they are connected locally to the high and low outputs in the confidence mode. K3 and K4 are controlled by outputs from the Current Limit Interface Assembly (A7). The confidence relay signals are buffered by two inverters in the A7U7. These drive the relay driver in A7U6 which drive the confidence relay. Resistors A7R10 and A7R13 limit the current to the confidence relay coils.

Relay common (A7J1-9) is not used as an active signal to control the relay drivers in A7U6. It is tied to the internal ground terminal E2 to isolate the relay ground return current from the signal circuits.

3.2.13 MAIN POWER SUPPLY

A schematic diagram for the DC power supply is a part of drawing 4150-099. This power supply delivers $\pm$48.0 volts $\pm$5% at 35 amperes DC with less than 2 volts peak-to-peak ripple from the three-phase 208 volt, 60 Hz AC line. These unregulated supplies consist of rectifier assemblies CR1 and CR2, and filter capaci-

tors C1 thru C4 connected in a conventional fashion.

The DC power supply delivers approximately ±53 volts DC with less than 1 volt peak-to-peak ripple from the three-phase 208 volt, 60 Hz AC line under no load conditions.

3.2.14 AUXILIARY POWER SUPPLY

The auxiliary power supply consists of the S8 secondary winding of T1, (terminals 36, 37 and 38) and bridge rectifier A1CR18 with associated components including filter capacitors A1C21 and A1C22. These components provide ±62 VDC ±5% power supplies to transistors A1Q1 thru A1Q6. Transistors A1Q1 thru A1Q6 provide the necessary voltage gain and current gain to drive the positive and negative power amplifiers. Typical loads on the ±62 VDC power supplies are less than 100 ma, typical ripple is less than 0.5 volts peak-to-peak.

3.2.15 PROGRAMMABLE AC POWER CONTROLLER POWER SUPPLY

The AC power controller power supply is part of the A7 assembly. Transformer A7T1 reduces the 115 VAC from T1 to the required levels.

The +5 supply consists of A7CR1, A7CR2, A7U1, A7C1, A7C2 and A7C3. Diodes A1CR1 and A7CR2 rectify the AC voltage from A7T1. A7U1 acts as a series-pass regulator to control the output to +5 volts DC. Capacitors A7C1, A7C2 and A7C3 provide filtering.

The +15 and -15 volt power supply includes diode bridge A7CR3, which rectify the AC voltage from A7T1. A7U4 and A7U5 provide the series-pass regulation of the +15 and -15 volt supplies. Capacitors A7C4 through A7C9 perform the filtering.

The power fault circuit sends a logic low ($\overline{\text{PWR FLT}}$) to the AC power controller just before the +5 supply falls below regulation limits. The programmable zener A7U2 monitors the input voltage to A7U1 and turns A7Q1 off when the voltage falls below approximately 7 VDC. Inverter A7U3 establishes the correct signal polarity.

The power sense relay A7K1 is held open by A7U6 when +5V is present and $\overline{\text{FLT}}$ is high. The relay closes connecting SRQ1 and SRQ2 when $\overline{\text{FLT}}$ or the +5V goes low.

3.2.16 FRONT PANEL METER

The front panel meter M1 has a full scale sensitivity of 0 to 1 milliampere DC and an internal resistance of approximately 34 ohms. The meter has a single scale with a full scale range of 0 to 300 volts AC. The meter rectifiers and scaling circuitry are contained on the A2 assembly shown in drawing 4995-611. The meter circuitry consists of rectifier diodes A2CR1 through A2CR4, potentiometer A2R4 and associated components. The four rectifier diodes are connected so as to form a full wave bridge rectifier.

Potentiometer A2R4 is used to shunt a small portion of the meter current and provide a sensitivity adjustment for full scale.

CAUTION

HIGH VOLTAGE (300 VAC)

Voltages up to 300 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits and the output circuits of the power source.

SECTION IV

CALIBRATION PROCEDURE

4.1 GENERAL

The following calibration and test procedures, or any part of them, may be performed on a routine basis to ensure that the Model 1751TC-3204 Power Source remains within specified tolerances. These procedures should always be performed after any repairs have been made to the unit. For your convenience, Table 4-1 lists the paragraph titles and page numbers for the calibration and test procedures.

Table 4-1 Calibration Procedure Listing

PARAGRAPH	PROCEDURE	PAGE
4.2	TEST EQUIPMENT REQUIRED	34
4.3	INITIAL ADJUSTMENTS	38
4.4	OVERLOAD VERIFICATION AND HARMONIC DISTORTION TEST	41
4.5	MAXIMUM LOAD INPUT POWER TEST	42
4.6	LINE REGULATION TEST	43
4.7	LOAD REGULATION ADJUSTMENT	44
4.8	24 HOUR AMPLITUDE STABILITY TEST	46
4.9	FREQUENCY RESPONSE TEST	49
4.10	AC NOISE LEVEL TEST	49
4.11	0.7 LAGGING POWER FACTOR TEST	53
4.12	0.7 LEADING POWER FACTOR TEST	53
4.13	CURRENT LIMIT TEST	54

The calibration procedures, unless stated otherwise, assume the power source is set on the 0 to 150 volt range and that the 4848-406 Test Fixture Current Limit switch is in the "OFF" position. Performance is very similar on the 0 to 75 and 0 to 300 range. Table 4-3 lists the voltages and output loads when evaluating the power source on the various output voltage ranges.

Paragraph 2.4 explains the procedure for changing the output voltage ranges and Paragraph 2.8 describes some potential problems associated with output wiring IR drop on all voltage ranges. When checking load regulation and amplitude stability, care should be taken to use a four-wire connection such that the external load and the measurement equipment have completely separate wiring from J2 at the rear of the power source.

Table 4-2 Adjustable Component Listing

CIRCUIT DESIGNATOR	VALUE	DESCRIPTION	PARA-GRAPH
R1	10K	CHASSIS MOUNTED COMPONENTS Front Panel "Gain" Control	4.3
R2	100 ADJ	Load Regulation Adjust.	4.8
A1		PREAMP CIRCUIT BOARD	
A1 R42		Negative Current Limit	
A1 R43		Positive Current Limit	4.4.1
A1 R54		EXCESSIVE LOAD Indicator	
A2		METER DRIVE BOARD	
A2 R4	1K ADJ	Full scale meter adjustment	4.3.3

NOTE: All resistors are in ohms

TABLE 4-3 Calibration Output Voltages, Load Settings and Tolerances

100% of Rated Output	75 VAC	150 VAC	300 VAC
Resistive Load for 1750 VA Output at 100% of Rated Output Voltage	3.21 ohms	12.86 ohms	51.43 ohms
Line Regulation Tolerances (±.25%)	±.188 VAC	±.375 VAC	±.75 VAC
Load Regulation Tolerances:			
45 Hz to 2 KHz (±3.33%)	±2.5 VAC	±5.0 VAC	±10.0 VAC
45 Hz to 5.6 KHz (±4.67%)	±3.5 VAC	±7.0 VAC	±14.0 VAC
AC Noise Level Tolerances:			
-65 dB shorted input	42mV rms	84mV rms	169mV rms
-40 dB @ full power	2.12V P-P	4.24V P-P	8.48V P-P
Amplitude Stability Tolerances (±.25%)	±.188 VAC	±.375 VAC	±.75 VAC
Frequency Response Tolerances (±.5 dB)	±4.27 VAC	±8.55 VAC	±17.1 VAC
93.3% of Rated Output	**70 VAC**	**140 VAC**	**280 VAC**
Resistive Load for 1750 VA Output at 93.3% of Rated Output Voltage	2.8 ohms	11.2 ohms	44.8 ohms
Line Regulation Tolerances (±.25%)	±.175 VAC	±.35 VAC	±.70 VAC
Load Regulation Tolerances:			
45 Hz to 2 KHz (±3.33%)	2.33 VAC	4.66 VAC	9.32 VAC
45 Hz to 5.6 KHz (±4.67%)	3.27 VAC	6.54 VAC	13.08 VAC
AC Noise Level Tolerances:			
-65 dB shorted input	39.4mV rms	78.8mV rms	157.4mV rms
-40 dB @ full power	1.98V P-P	3.96V P-P	7.92V P-P
Amplitude Stability Tolerances (±.25%)	±.188 VAC	±.375 VAC	±.75 VAC

NOTE

All loads must be able to dissipate 1750 watts and have no inductive or capacitive reactance.

TABLE 4-4 Current Limit Values and Tolerances

	0 - 75 VAC	0 - 150 VAC	0-300 VAC
100% Current Limit Values	25 amps	12.5 amps	6.25 amps
Current Limit Tolerances:			
45 Hz to 2.0 KHz (±2.0%)	±.5 amps	.25 amps	±.125 amps
2 KHz to 5.6 KHz (±5.0%)	±1.25 amps	±.625 amps	±.3125 amps

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedures assuming the input line voltage has a nominal value of 208 volts rms and the power source is tested on the 0 to 150 volt AC range. Some equipment substitutions will be required for other line voltages and ranges.

a. Oscilloscope, Tektronix 5110N with 5A22N and 5B10N.

b. 3Ø 5.0 KVA Variac, Superior Electric 1156D or equivalent.

c. Power Analyzer, Magtrol 4610 or equivalent.

d. Distortion Analyzer, H.P. 334A or equivalent.

e. Programmable DMM, Keithley 192 with Model 1910 averaging AC volts option and Model 1923 IEEE-488 interface option or equivalent.

f. Multi-range 1750 watt load box, as defined in Table 4-3. Dale type NHL resistors or equivalent.

g. Variable Oscillator, Wavetek 21 or equivalent.

h. Wide Band Current Transformer, Pearson Electronics Model 411 or equivalent.

i. Plug-in Test Fixture, California Instruments Model 4848-406.

(NOTE: The following additional equipment is required to perform the 24 Hour Amplitude Stability Test.)

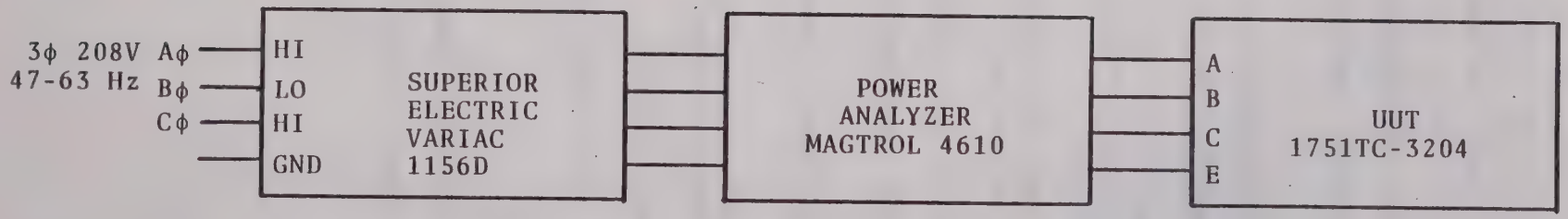
j. Printer, Hewlett Packard Model 82905B.

k. Computer Controller with I/O ROM, Hewlett Packard Model 87.

l. Scanner, Keithley Model 705.

m. High Voltage Scanner Card, Keithley Model 7054.

n. Disc Drive, Hewlett Packard Model 9121D.



Unit is wired for three phase
208 ±10% volts AC line operation.

FIGURE 4-1 1751TC-3204 AC Input Power Connection

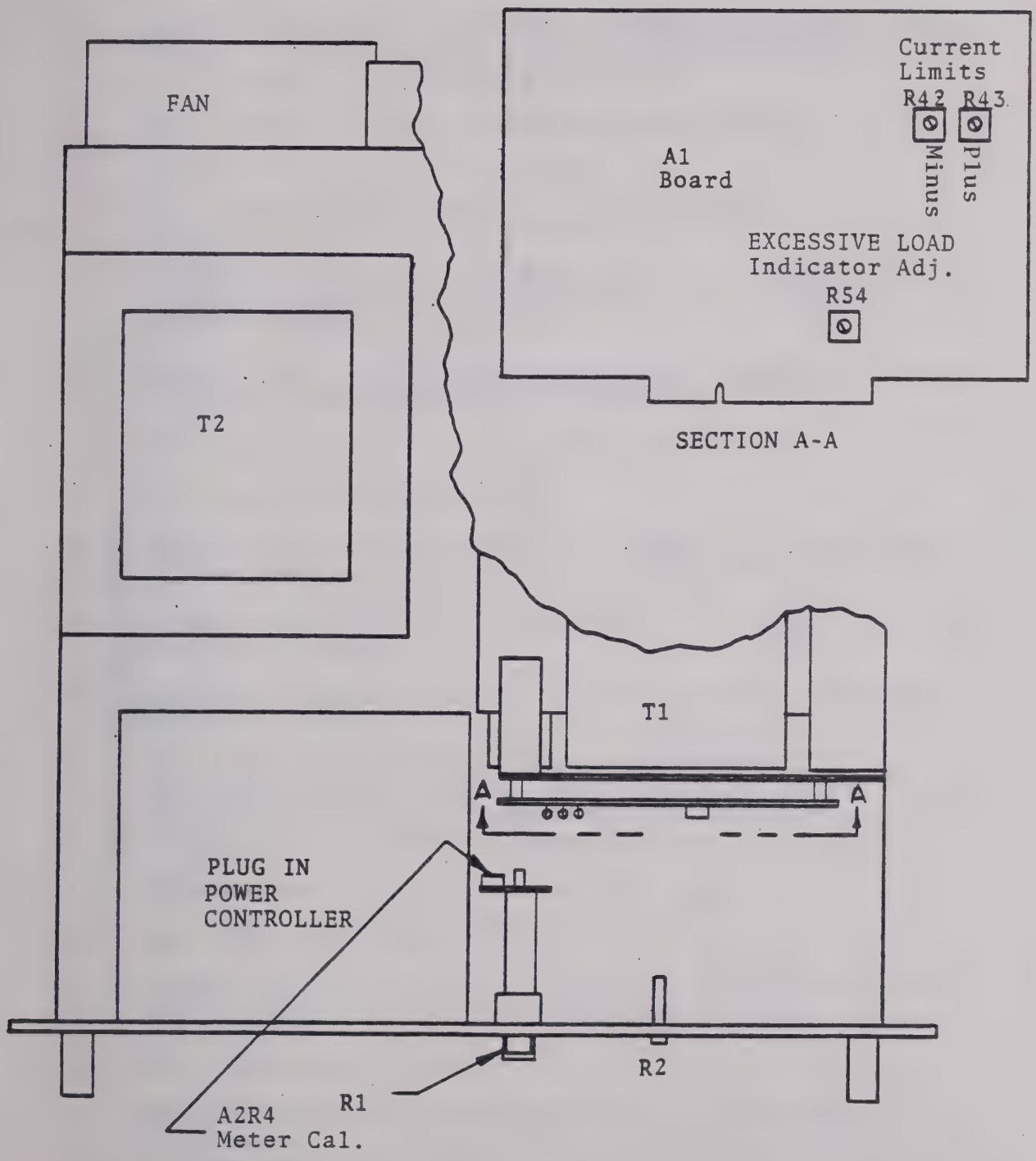
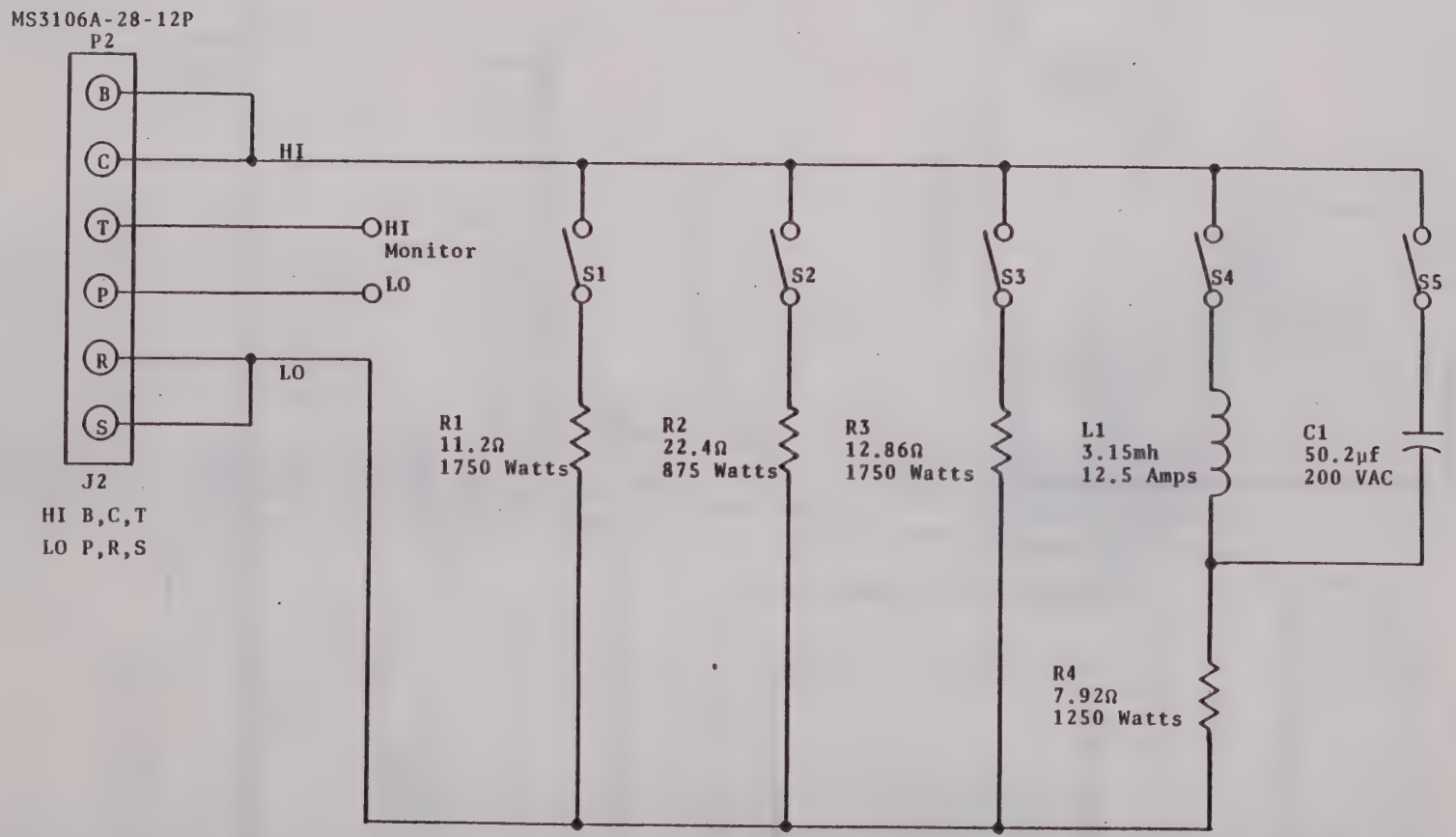


FIGURE 4-2
Internal Adjustments for Model 1751TC-3204 Power Source



1751TC-3204
Figure 4-3 1750 VA Load Assembly

4.3 INITIAL ADJUSTMENTS

4.3.1 Check Input Power Level

1. Connect the Model 1751TC-3204 Power Source power inputs shown in Figure 4-1 and power output with monitors and load as shown in Figures 4-3 and 4-4.

2. Turn the GAIN control fully counterclockwise.

3. Adjust the VARIAC for 208 volts AC.

4.3.2 Adjust Front Panel Meter Reading.

1. Connect a digital multimeter to the output monitor jacks on the 1750 VA Load Assembly (see Figure 4-3) or to J2-T (Hi) and J2-P (Low).

2. Select the 0 to 300 volt range with the output range switch on the 4848-406 Test Fixture.

3. Set the external oscillator output to 400 Hz.

4. Turn the power source "ON".

5. Adjust the external oscillator output for approximately 7 VAC out.

6. Adjust the GAIN control for a 300 volt reading on the digital multimeter.

7. Adjust A2R4 (see Figure 4-2) so the front panel meter reads 300 volts.

8. Vary the external oscillator output from 45 Hz to 5.6 KHz while maintaining the output voltage of 300 volts and verify the meter reads within 3% of 300 volts (±9.0 volts) over the entire frequency range.

4.3.3 Midband Load Regulation Adjustment

1. Turn the power source "OFF".

2. Select the 150 VAC output range with the output range selector switch on the 4848-406 Test Fixture.

3. Turn the power source "ON".

4. Set the external oscillator output frequency to 400 Hz.

5. Adjust the front panel GAIN control for 140 VAC output.

6. Close "S1" on the 1750 VA Load Assembly (100% load at 93.3% output voltage).

7. Adjust the front panel REG control for 140 VAC ±.10 VAC.

8. Open "S1" on the 1750 VA Load Assembly.

9. Repeat steps 4.3.3.5 through 4.3.3.8 until the change between the full load voltage and the no load voltage is less than 100 mVAC

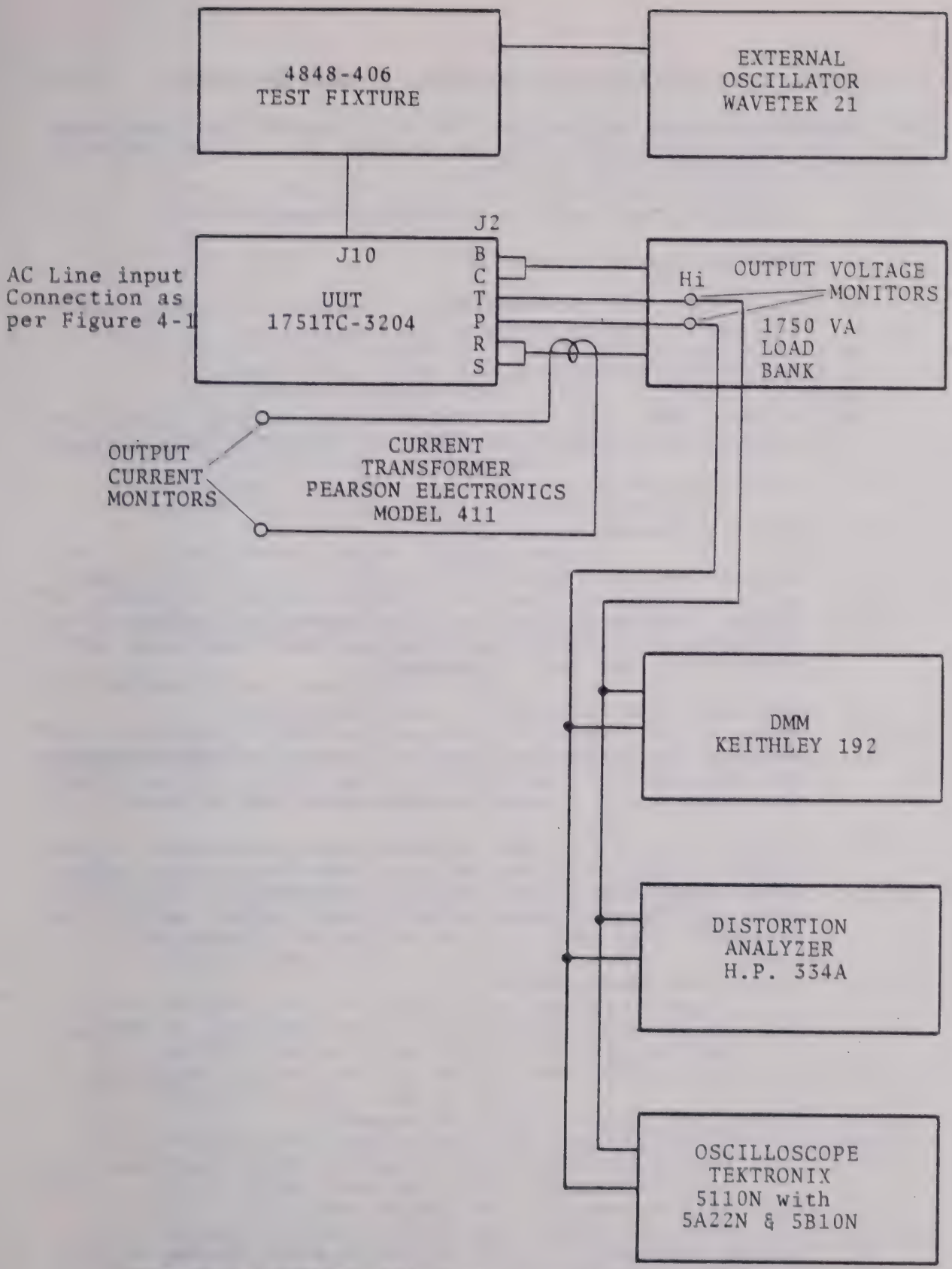


FIGURE 4-4 1751TC-3204 Test Circuit Connection

4.4 OVERLOAD VERIFICATION AND HARMONIC DISTORTION TESTS

The following steps may be used to test response to overloads under the worst case conditions and verify acceptable harmonic distortion content of the waveform.

4.4.1 Setup For Overload and Distortion Tests

1. Turn the power source "OFF".
2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.
3. Adjust the VARIAC for 208 volts AC.
4. Select the 0 to 150 output voltage range with the output range select switch on the 4848-406 Test Fixture.
5. Adjust the external oscillator for 5.6 KHz.
6. Turn the power source "ON".
7. Adjust the front panel GAIN control for 140 VAC output.
8. Close "S1" on the 1750 VA Load Assembly (100% load at 93.3% output voltage) and readjust the front panel GAIN control for 140 VAC if necessary.
9. Set A1R42 and A1R43 fully counterclockwise.
10. Monitor the distortion meter and adjust A1R42 clockwise for a distortion reading of 0.4 to 0.45%. Adjust A1R43 clockwise for a distortion reading of 0.6 to 0.65%.
11. Adjust A1R54 fully counterclockwise then advance A1R54 in the clockwise direction until the front panel EXCESSIVE LOAD indicator is dimly illuminated. Turn A1R54 counterclockwise (approximately 10 degrees) until the EXCESSIVE LOAD indicator is no longer illuminated.

4.4.2 Distortion Measurements

1. Set the external oscillator output frequency to 400 Hz.
2. Adjust the GAIN control for 140 VAC output amplitude.
3. Close "S1" on the 1750 Load Assembly.
4. Verify that the Distortion Analyzer reads less than 1%.
5. Open "S1" on the 1750 VA Load Assembly.
6. Repeat paragraph 4.4.2.1 through 4.4.2.5 at the following output frequencies: 45 Hz, 1 KHz, 3 KHz and 5.6 KHz.

4.4.3 Overload Tests

1. Momentarily close "S2" on the 1750 VA Load Assembly (50% overload at 93.3% output).

2. Verify that both the plus and minus peaks of the output waveshape are clipped.

3. Open "S2".

NOTE

If "S2" is left in the closed position for more than 10 to 15 seconds the front panel circuit breaker may trip. If this occurs open "S1" and "S2" on the 1750 VA Load Assembly. Turn the power source on and continue at paragraph 4.4.1.7.

4. Open "S1" on the 1750 VA Load Assembly.

4.4.4 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.

4.5 MAXIMUM LOAD INPUT POWER TEST

The following steps may be used to measure input power during maximum loads and worst case conditions.

4.5.1 Setup for Input Power Tests

1. Turn the power source "OFF".

2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.

3. Adjust the Variac for 208 volts AC.

4. Select the 0 to 150 output voltage range.

5. Adjust the external oscillator for 400 Hz.

6. Turn the power source "ON".

7. Adjust the front panel GAIN control for 140 VAC output.

4.5.2 Test Input Power at 93.3% Output Voltage

1. Close "S1" on 1750 VA Load Assembly (100% load at 93.3% output voltage).

2. Adjust the Variac for 229 volts AC.

3. The power analyzer should indicate less than 4290 watts of input power.

4. Open "S1" on the 1750 VA Load Assembly.

4.5.3 Test Input Power at 100% Output Voltage

1. Adjust the GAIN control for 150 volt output.

2. Close the "S3" on 1750 VA Load Assembly (100% load at 100% voltage).

3. Adjust the Variac for 229 volts AC.

4. The power analyzer should indicate less than 4070 watts of input power.

5. Open "S3" on the 1750 VA Load Assembly.

4.5.4 Test Input Power at No Load Condition

1. Verify that all switches on 1750 VA Load Assembly are in the open position.

2. Adjust the Variac for 229 volts AC.

3. Adjust the GAIN control for 150 volts output.

4. The power analyzer should indicate less than 350 watts of input power.

4.5.5 Test Other Output Voltage Ranges.

The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance and output voltage levels should be taken from Table 4-3.

NOTE

Input power readings will remain the same on all three output ranges.

4.6 LINE REGULATION TEST

The following steps may be used to test response to changes in AC input line voltage under the worst case conditions.

NOTE

Care should be taken to ensure the amplitude and frequency of the signal from the oscillator remains stable and independent of line conditions during this test.

4.6.1 Setup For Line Regulation Tests

1. Turn the power source "OFF".

2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.

3. Adjust the Variac for 208 volts AC.

4. Select the 0 to 150 output voltage range with output range select switch on the 4848-406 Test Fixture.

5. Adjust the external oscillator for 400 Hz.

6. Turn the power source "ON".

4.6.2 Test AC Input Line Regulation.

1. Adjust the GAIN control for 150 VAC output.

2. Close "S3" on the 1750 VA Load Assembly (100% load at 100% output voltage).

3. The oscilloscope should show a clean sine wave output. The distortion analyzer should indicate less than 1.0% distortion.

4. Monitor the output voltage while adjusting the input voltage from 187V to 229 VAC. Verify that the output voltage does not change more than 0.375 volts rms as the input voltage is varied.

5. Repeat Paragraph 4.6.2.1 through 4.6.2.4 at 45 Hz, 2 KHz and 5.6 KHz output frequencies.

4.6.3 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.

4.7 LOAD REGULATION ADJUSTMENT

4.7.1 Setup for Load Regulation Adjustments

1. Turn the power source "OFF".

2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.

3. Set the digital multimeter on the 200 VAC range and connect it to the monitor jacks on the 1750 VA Load Assembly.

4. Adjust the Variac for 208 volts AC.

5. Select the 0 to 150 output voltage range with the output range select switch on the 4848-406 Test Fixture.

6. Turn the power source "ON".

4.7.2 Load Regulation Verification at 400 Hz

1. Set the external oscillator output frequency to 400 Hz.

2. Adjust the front panel GAIN control for 140 VAC output.

3. Close "S1" on the 1750 VA Load Assembly (100% load at 93.3% output voltage).

4. Adjust the front panel REG control for 140 VAC ±.10 VAC.

5. Open "S1" on the 1750 VA Load Assembly.

6. Repeat steps 4.7.2.2 through 4.7.2.5 until the change between the full load voltage and the no load voltage is less than 100 mVAC.

4.7.3 Load Regulation Verification at 2 KHz.

1. Adjust the external oscillator for 2 KHz.

2. Adjust the GAIN control for an output of 140 volts.

3. Close "S1" on the 1750 VA Load Assembly.

4. Verify that the output voltage change is less than 4.66 VAC when "S1" is closed.

5. Open "S1".

4.7.4 Load Regulation Verification at 45 Hz

1. Adjust the external oscillator for 45 Hz.

2. Adjust the GAIN control for an output of 140 volts.

3. Close "S1" on the 1750 VA Load Assembly.

4. Verify that the output voltage change is less than 4.66 VAC when "S1" is closed.

5. Open "S1".

4.7.5 Load Regulation Verification at 5.6 KHz

1. Adjust the external oscillator for 5.6 KHz.

2. Adjust the GAIN control for an output of 140 volts.

3. Close "S1" on the 1750 VA Load Assembly.

4. Verify that the output voltage change is less than 6.54 VAC when "S1" is closed.

5. Open "S1".

4.7.6 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.

4.8 24 HOUR AMPLITUDE STABILITY TEST

The following test is to be used to establish 24 hour stability of the Model 1751TC-3204 Power Source. The test is primarily concerned with identifying changes in amplitude due to circuit changes during operation.

4.8.1 Setup for Amplitude Stability Test

1. Turn the power source "OFF".

2. Connect the power source as shown in Figure 4-5.

3. Verify that the Channel 1 input of the Keithley Scanner Model 705 is connected to the oscillator output/power amplifier input jack (IN MON) on the 4848-406 Test Fixture. Also verify that Channel 2 input of the scanner is connected to the 1751TC-3204 Power Source output via the output monitor jacks of the 1750 VA Load Assembly. Verify that the output from the scanner is connected to the input of the Keithley 192 DMM.

4. Set the IEEE-488 primary address switches on the equipment as follows:

    1. Voltmeter: 4
    2. Scanner: 8
    3. Printer: 1

5. Load the program contained in Appendix B into the Hewlett Packard 87 CPU.

6. Adjust the Variac for 208 volts AC.

7. Select the 0 to 150 output voltage range using the output range selection switch on the 4848-406 Test Fixture.

8. Adjust the external oscillator for 400 Hz.

9. Turn the power source "ON".

4.8.2 Record Amplitude Drift

1. Adjust the GAIN control for 140 volt output.

2. Close "S1" on the 1750 VA Load Assembly (100% load at 93.3 output voltage).

3. Disregard the drift during the first hour.

4. Ensure that the ambient temperature does not change more than ±3 degrees Centigrade during the 24 hour test.

5. Start the program after the first hour temperature stabilization period.

6. The test equipment will automatically record the output voltage for 24 hours. Verify that the percent of gain change does not exceed ±.25%.

4.8.3 Record Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and the 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.

NOTE

If an 848TCM-3205 Programmable Plug-in AC Power Controller is used as the signal generator, the power source must be connected to the IEEE-488 GPIB. The address switch of the power controller must be set at 2. The CPU will automatically set the power controller to the proper voltage and frequency.

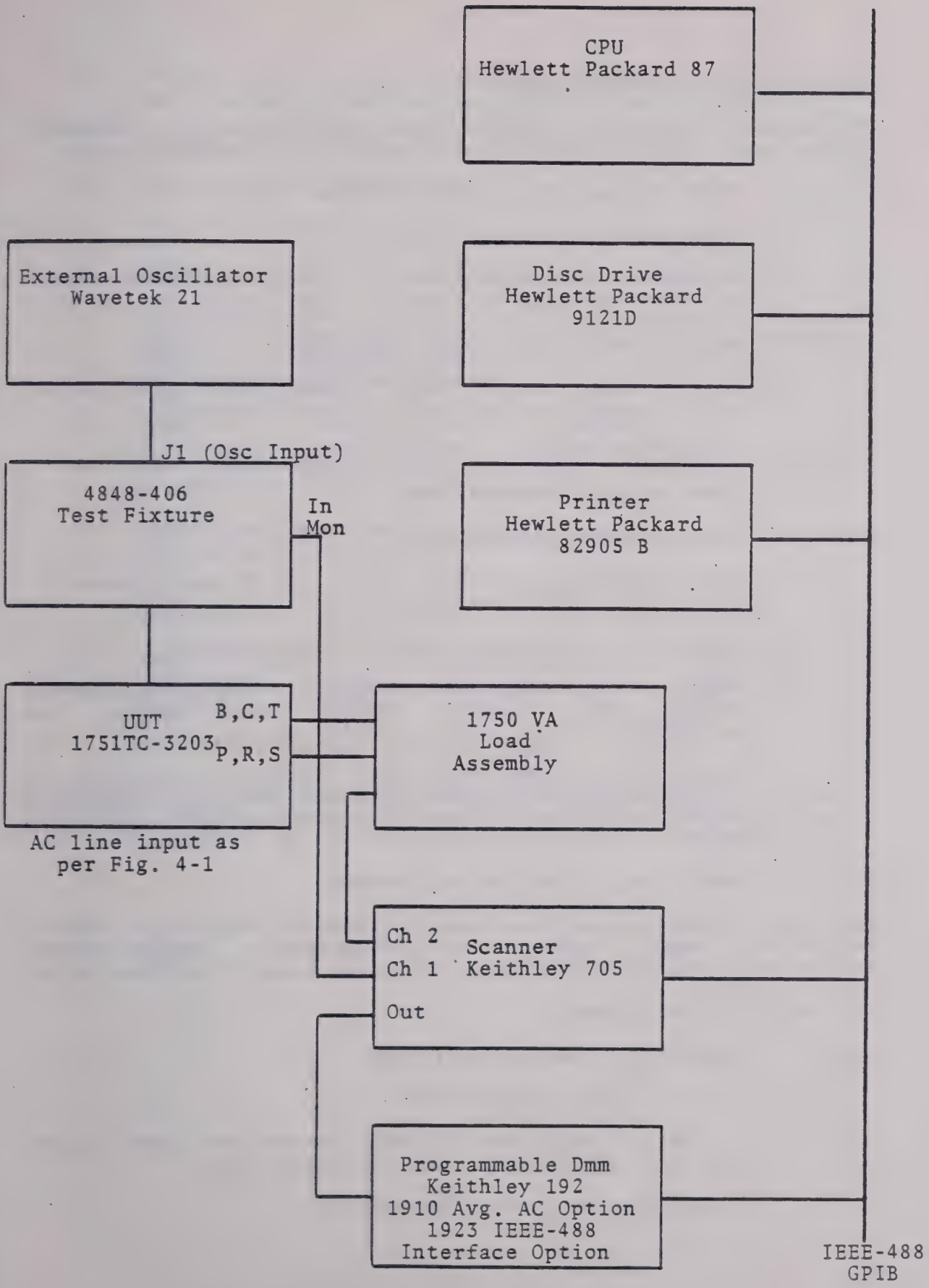


Figure 4-5 24 Hour Amplitude Stability Test

4.9 FREQUENCY RESPONSE TEST

The following steps are used to establish the frequency response of the power source over its entire operating frequency range.

4.9.1 Setup For Frequency Response Test

1. Turn the power source "OFF".
2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.
3. Adjust the Variac for 208 volts AC.
4. Select the 0 to 150 output voltage range with output select switch on the 4848-406 Test Fixture.
5. Adjust the external oscillator for 400 Hz.
6. Turn the power source "ON".

4.9.2 Test Frequency Response

1. Verify that all switches on the 1750 VA Load Assembly are in the "OFF" position.
2. Adjust the GAIN control for 150 volt output.
3. Monitor the output voltage on the digital multimeter during the following steps. Also monitor the oscillator voltage going into the unit.
4. Sweep the external oscillator frequency from 45 Hz to 5.6 KHz while holding the external oscillator amplitude constant. The output should not change more than ±8.55 volts.

4.9.3 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.

4.10 AC NOISE LEVEL TEST

4.10.1 Setup for AC Noise Level Test

1. Turn the power source "OFF".
2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.
3. Adjust the Variac for 208 volts AC.

4. Select the 0 to 150 output voltage range with output range select switch on the 4848-406 Test Fixture.

5. Adjust the external oscillator for 400 Hz.

6. Turn the power source "ON".

4.10.2 Test Noise Level

1. Adjust the GAIN control for 140 volt output.

2. Using the offset feature, adjust the scope to observe the positive peak of the 140 AC volt output signal at 1 volt per centimeter sensitivity and a sweep rate of 5 milliseconds per centimeter.

3. Close "S1" on the 1750 VA Load Assembly.

4. The peak-to-peak noise and ripple should not exceed 3.96 volts (40 dB below full output).

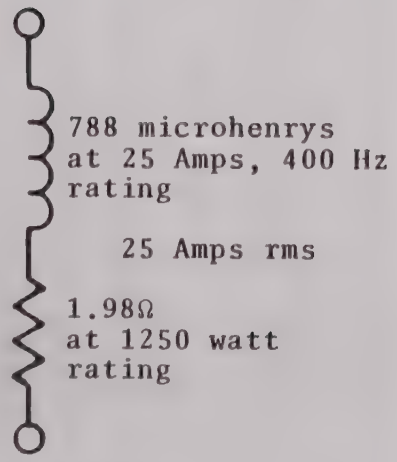
5. Disconnect the external oscillator output from the 4848-406 Test Fixture input.

6. Short the external oscillator input BNC connector on the 4848-406 Test Fixture.

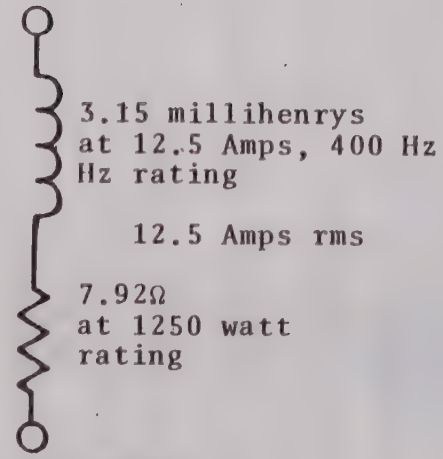
7. The rms value of the noise as indicated by the digital multimeter should not exceed 78.8 mVAC (65 dB below full output).

4.10.3 Test Other Output Voltage Ranges

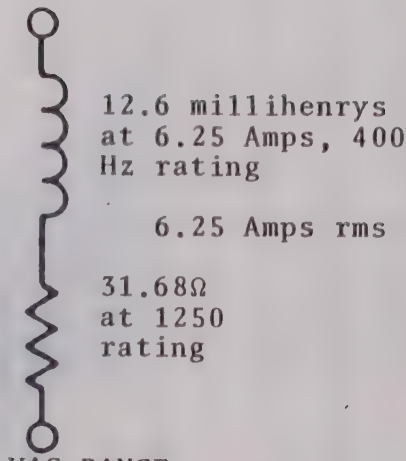
The above procedures may also be performed for the 0 to 75 and 0 to 300 volt output ranges. The load impedance, output voltage levels and acceptable tolerances should be taken from Table 4-3.



75 VAC RANGE
1750 VA 0.7 of Load
at 70 VAC 400 Hz



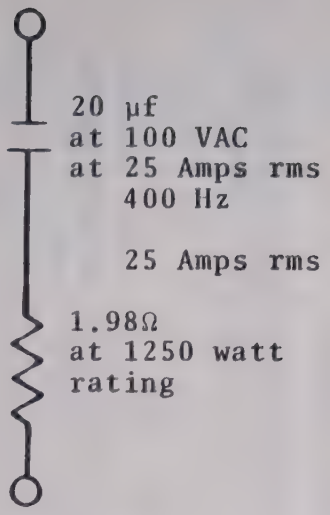
150 VAC RANGE
1750 VA 0.7 of Load
at 140 VAC 400 Hz



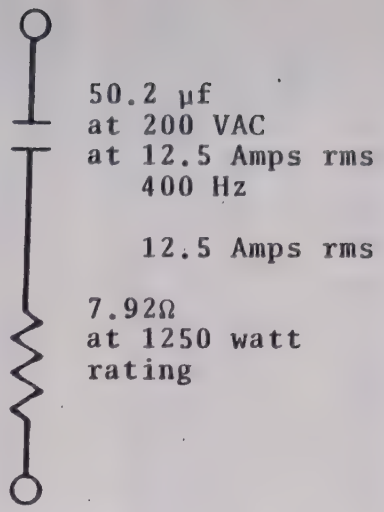
300 VAC RANGE
1750 VA 0.7 pf Load
at 280 VAC 400 Hz

FIGURE 4-6

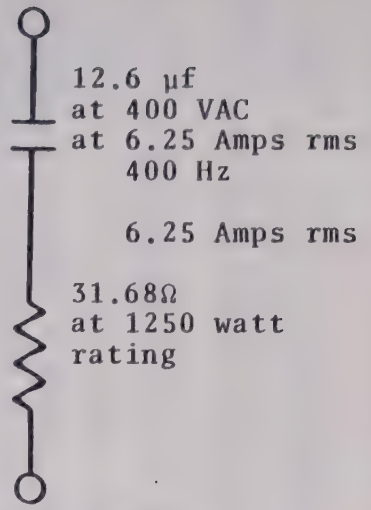
1750 VA 0.7 Lagging Power Factor Loads at 400 Hz



75 VAC RANGE
1750 VA 0.7 pf Load
at 70 VAC 400 Hz



150 VAC RANGE
1750 VA 0.7 pf Load
at 140 VAC 400 Hz



300 VAC RANGE
1750 VA 0.7 pf Load
at 280 VAC 400 Hz

FIGURE 4-7

1750 VA 0.7 Leading Power Factor Loads at 400 Hz

4.11 0.7 LAGGING POWER FACTOR TEST

The following steps are used to verify the ability of the power source to drive a 0.7 lagging power factor load.

4.11.1 Setup for Lagging Power Factor Adjustment

1. Turn the power source "OFF".
2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.
3. Adjust the Variac for 208 volts AC.
4. Select the 0 to 150 output voltage range with the output select switch on the 4848-406 Test Fixture.
5. Adjust the external oscillator for 400 Hz.
6. Turn the power source "ON".

4.11.2 Power Factor Test

1. Adjust the GAIN control for 140 volts output.
2. Close "S4" on the 1750 VA Load Assembly.
3. Verify the following:
   a. Output waveshape must remain a clean, undistorted sine wave.
   b. Output distortion must be less than 1%.
4. Open "S4".

4.11.3 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and the 0 to 300 volt ranges. The appropriate power factor loads may be taken from Figure 4-6.

4.12 0.7 LEADING POWER FACTOR TEST

The following steps are used to verify the ability of the power source to drive a 0.7 leading power factor load.

4.12.1 Setup for Leading Power Factor Adjustment

1. Turn the power source "OFF".
2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.

3. Adjust the Variac for 208 volts AC.

4. Select the 0 to 150 output voltage range with the output select switch on the 4848-406 Test Fixture.

5. Adjust the external oscillator for 400 Hz.

6. Turn the power source "ON".

4.12.2 Power Factor Test

1. Adjust the GAIN control for 140 volt output.

2. Close "S5" on the 1750 VA Load Assembly.

3. Verify the following:

   a. Output waveshape must remain a clean, undistorted sine wave.

   b. Output distortion must be less than 1%.

4. Open "S5".

4.12.3 Test Other Output Voltage Ranges

The above procedures may also be performed for the 0 to 75 and the 0 to 300 volt ranges. The appropriate power factor loads may be taken from Figure 4-7.

4.13 CURRENT LIMIT TEST

The following steps may be used to test the accuracy of the programmable current limit function that is provided by the A7 assembly.

4.13.1 Setup for Current Limit Tests

1. Turn the power source "OFF".

2. If not already accomplished, connect the power source and test circuits as shown in Figure 4-4.

3. Adjust the Variac for 208 VAC.

4. Select the 0 to 150 output voltage range using the range select switch on the 4848-406 Test Fixture.

5. Set the Current Limit switch on the 4848-406 Test Fixture to the "ON" position.

6. Adjust the external oscillator for 400 Hz.

7. Turn the power source "ON".

8. Set the Current Limit switch on the 4848-406 Test Fixture so that the voltage from Current Limit (TP-5) to Ground (TP-7) equals 9.76 VDC.

4.13.2 Test Current Limit

1. Adjust the GAIN control for 140 VAC output.

2. Close "S1" on the 1750 VA Load Assembly (100% load at 93.3% output voltage).

3. Momentarily close "S2" on the 1750 VA Load Assembly (50% overload at 93.3% output).

4. Verify that the power source output current is 12.5 amps ±.250 amps.

5. Open "S2".

6. Open "S1".

4.13.3 Test Other Output Voltage Ranges and Frequencies

The above procedures may also be performed for the 0 to 75 and the 0 to 300 volt ranges and at other frequencies. The load impedance, output voltage levels, output current levels and tolerances should be taken from Tables 4-3 and 4-4.

CAUTION

HIGH VOLTAGE (300 VAC)

Voltages up to 300 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits and the output circuits of the power source.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL

The California Instruments Model 1751TC-3204 Power Source is a solid state unit and should require minimum maintenance. It is forced air-cooled and will accumulate some dust with time. The power transistor positive and negative heatsinks should be cleaned at intervals not to exceed 6 months.

5.1.1 Heatsink Cleaning

CAUTION

Failure to keep the heatsinks clean will reduce their thermal transfer efficiency and could eventually cause failure of the power source.

The heatsinks can be cleaned by placing a compressed air nozzle against the cooling air intake grill. Blow the dust out of the rear of the power source while the forced air cooling fans are operating.

5.2 TROUBLESHOOTING

5.2.1 External Checks

If the problem appears to be in the power source, it must be isolated to a specific section of the unit. Before removing the covers, check that all three phases of the AC power input to the unit are of the proper amplitude and frequency. Check that the signal input to the power source is also of the proper amplitude (approximately 5 volts rms) and frequency (45 Hz to 5.6 KHz). Check that the output load on the power source is not excessive or that the load starting transients are not excessive.

5.2.2 Check DC Power Supply

Check all DC power supply voltages. Information concerning power supply ripple and voltage tolerance is given in Paragraph 3.2.13 and 3.2.14 of this instruction manual.

5.2.3 Check Power Amplifier Output

Check that the quasi-complementary symmetry output amplifier is operating properly and is not drawing excessive current under no load conditions. Section 3.2.5 of this instruction manual describes the operation of the power amplifier.

5.2.4 Check Overload Circuits

Check that the overload circuitry is operating properly The overload circuit may be disabled by adjusting A1R42 and A1R43 fully counterclockwise.

5.2.5 Check the Plug-in AC Power Controller

If the problem has been resolved to be in the AC Power Controller consult the 848TCM-3205 AC Power Controller manual.

SECTION VI

CIRCUIT DIAGRAMS

6.1 GENERAL

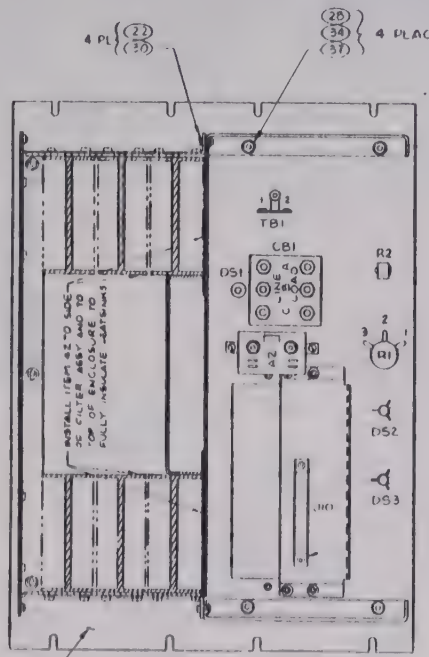
This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 1751TC-3204 AC Power Source. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on the schematic and mechanical drawings. To determine the complete reference designator, prefix the schematic or drawing reference designator with the assembly and/or sub-assembly designator. For example:

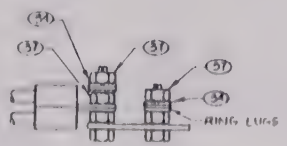
Assembly/Sub-Assembly	Component	Component Designation
A1	C8	A1C8
None	T1	T1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	NOTE PL CHANGE		
B	CHANGE HARDWARE FOR TB7		
C	HEATSINK HARDWARE WAS 24 & 33		
D	NUTS SHOWN IN DWG		
E	PL CHANGE OF J11 HARDWARE		
F	REVISED SHEET 2		
G	REVISED PARTS LIST		
H	REVISED MODEL NUMBER		



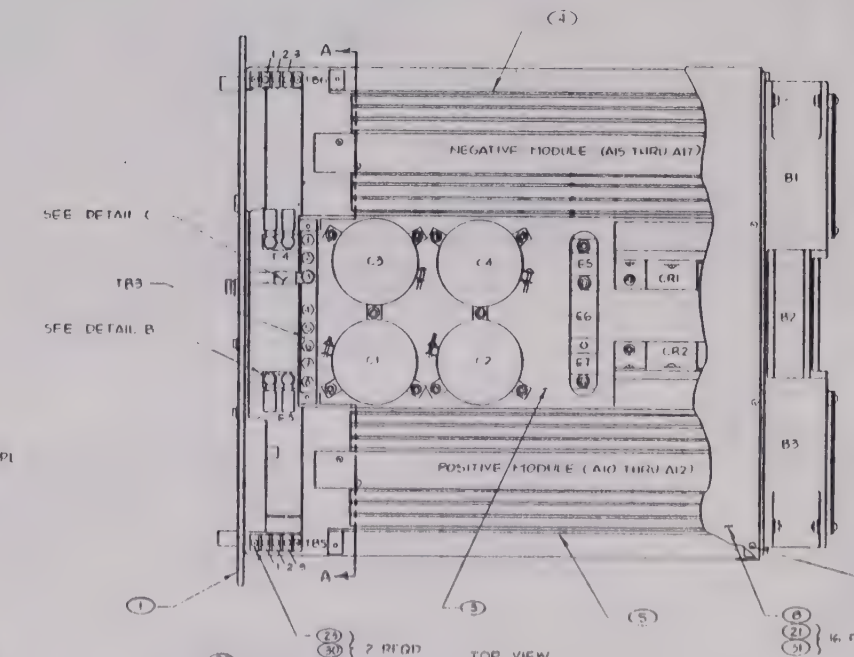
VIEW A-A
(VIEWED FROM INSIDE)

(15) (25) (35) 2 PL



DETAIL B
TYP - 2PL

DETAIL C
PIGGY BACK MIS-OF TERMINALS
ALSO TYP END ALL NO 8 & NO 10 AWG
CONDUCTORS WHERE APPLICABLE



CONNECTOR MATING TABLE		
P13	TO	A1 J1
P14	TO	A1 J2
P15	TO	A2 J1

⚠ SECURE R31 & C5 USING ITEM 10
1. FOR SCHEMATIC, SEE 4150 099

NOTES: (UNLESS OTHERWISE SPECIFIED)

FOR PARTS LIST SEE PL 4150 442-1

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL SPECIFICATION	COM IDENT	NOTE NO
	1751TC-3204	END ITEM			

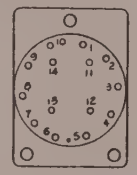
LIST OF MATERIAL

TOP ASSEMBLY, 1751TC 3204B

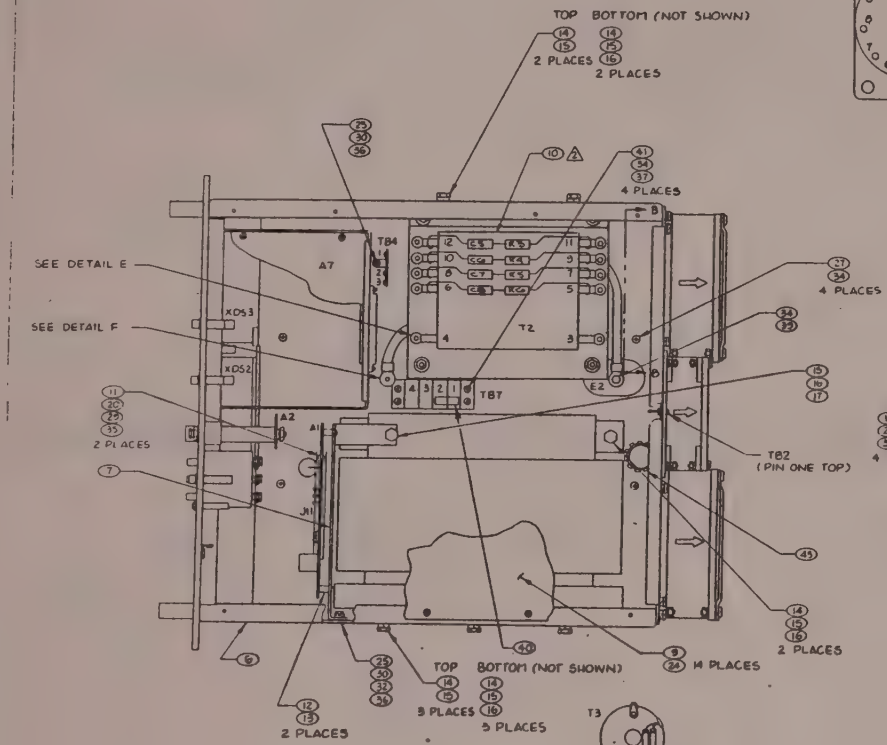
California Instruments

4150 442 H

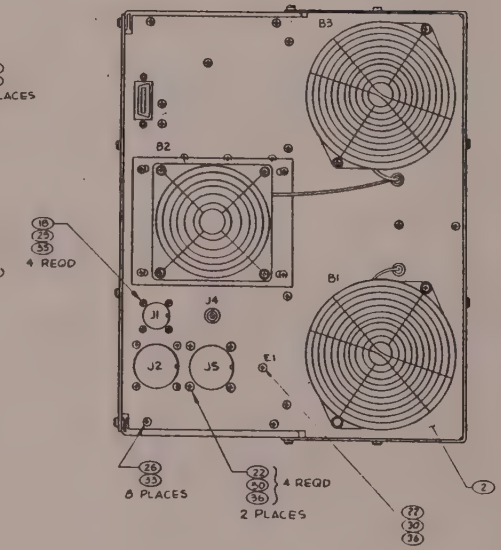
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
F	ADDED R93 / CAP ACROSS T2 SEE WINDINGS		

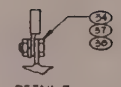


DETAIL D BOTTOM VIEW
PIN NUMBERING NO SCALE

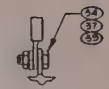


VIEW B-B
FOR PIN OUT OF K1 THRU K5 SEE DETAIL D





DETAIL E
SCALE 1/1
TYP T2-3 THRU T2-12



DETAIL F
SCALE 1/1
T2-1

NOTES (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XX ± .010 .XXX ± .03 ANG ± 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √

DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS CORPORATION AND SHALL NOT BE REPRODUCED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: TOP ASSEMBLY. 17S1TC-3204 A

California Instruments
A DIVISION OF AMETEK TECHNICAL SERVICES CO. INC. SAN DIEGO, CALIFORNIA

RELEASE	[illegible]	9/21/64	ADDITIONAL APPROVALS
PROJ ENGR	[illegible]	9/18/64	
CHECK	BEACH	9-8-64	
DESIGN			
DRAFT	STANIARSKI	4/64	

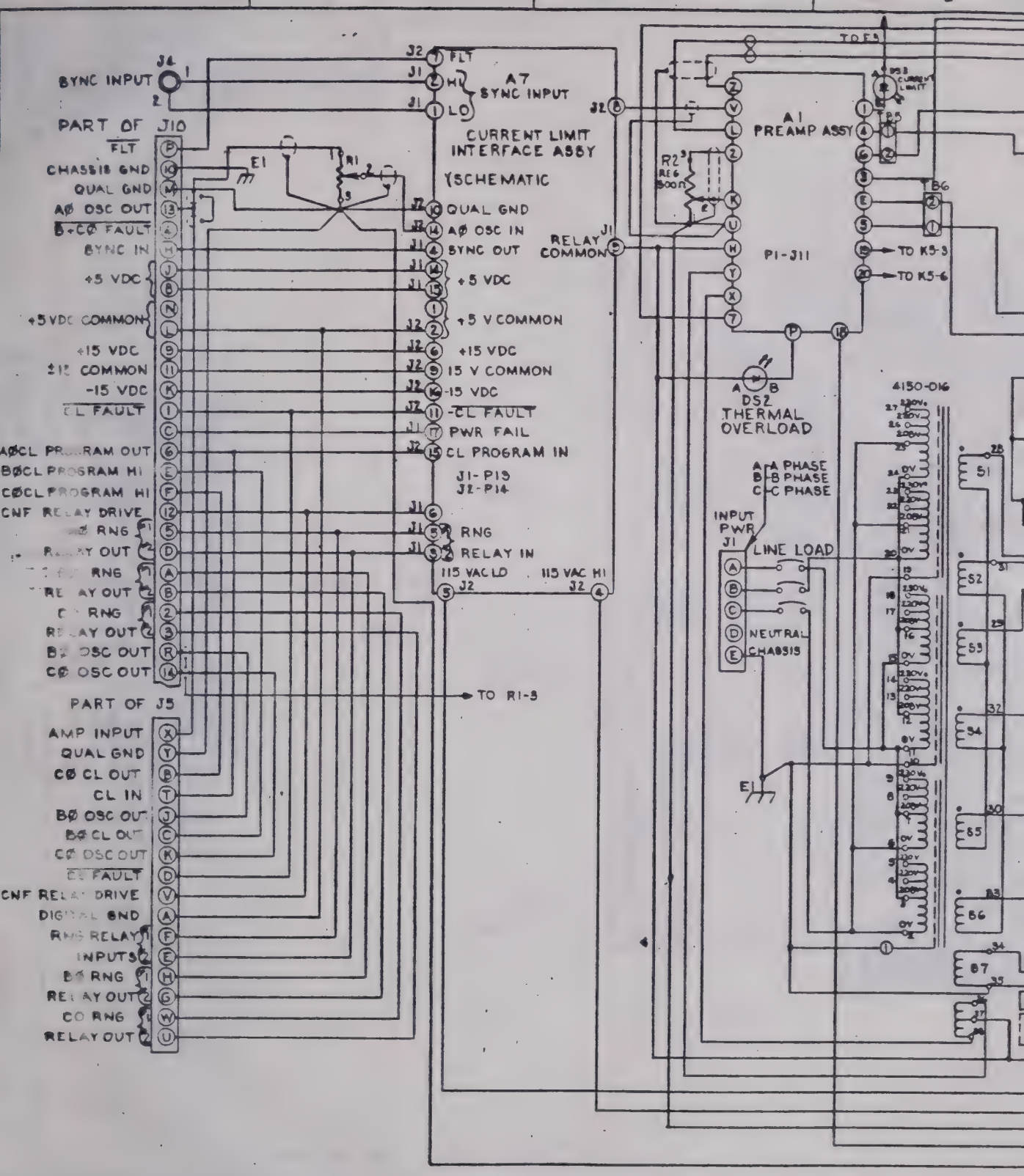
CONTRACT NO

DWG NO 4150-442 REV F

SCALE 1/2 SHEET 2 OF 2

QTY REQD	USED ON	NEXT ASSY
	17S1TC-3204	END ITEM

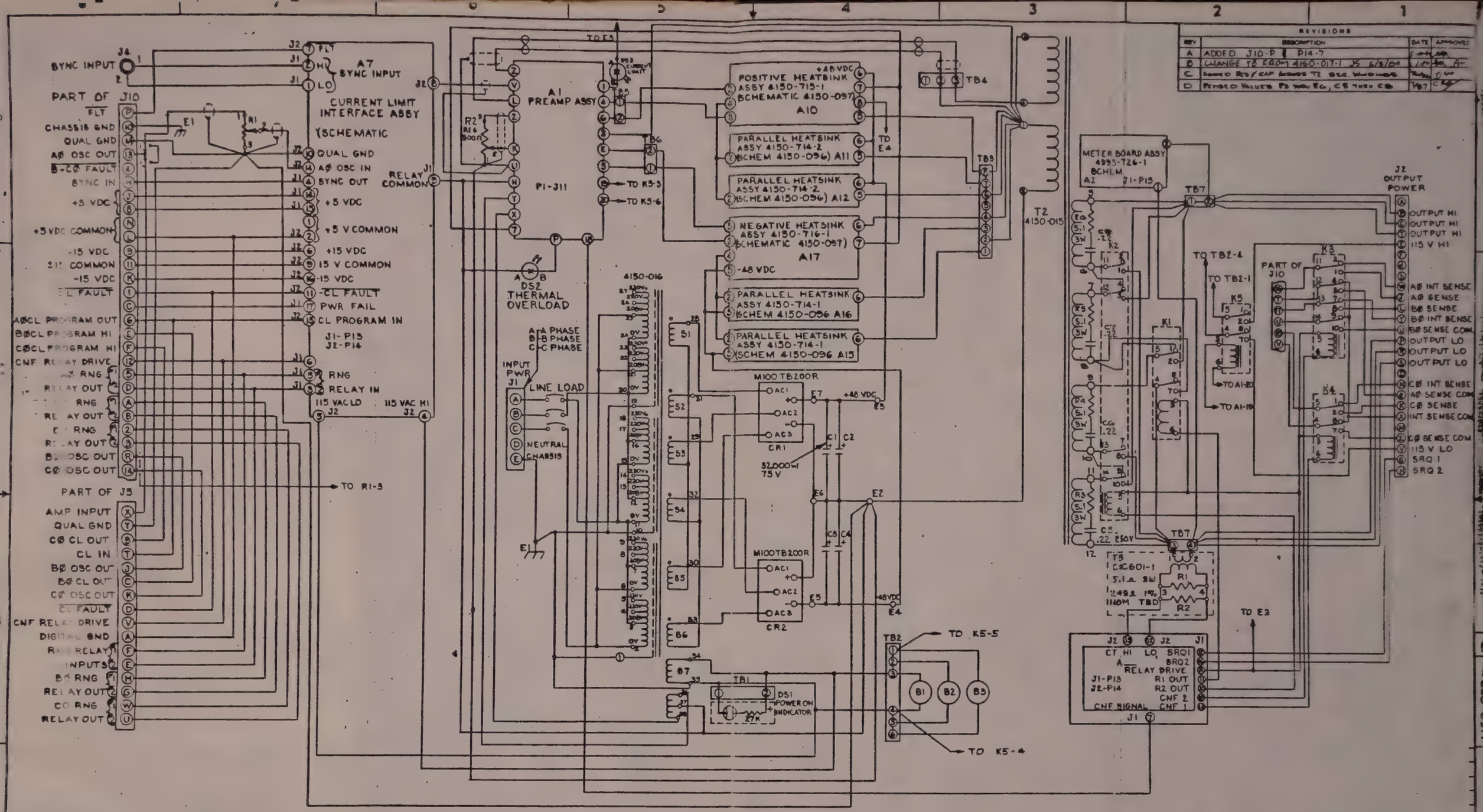
FINISH



2. ALL CAPACITANCE IN MICROFARADS.
1. ALL RESISTANCE IN OHMS, RESISTORS ARE ¼ W, 5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

8 | 7 | 6 | 5



REV	DESCRIPTION	DATE	APPROVED
A	ADDED J10-P [illegible] P14-7		
B	CHANGE TB FROM 4150-017-1 TO 6/8/84		
C	ADDED R23/CAP ACROSS T2 SEC. WINDINGS		
D	REVISED VALUES R5 FROM 5Ω, C5 FROM .22	1987	

2. ALL CAPACITANCE IN MICROFARADS.
1. ALL RESISTANCE IN OHMS, RESISTORS ARE ¼W, 5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REF 1751TC-3204 4150-442-1

LIST OF MATERIAL

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

REQD PER ASSY

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .030 ANGLES ± 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE D

UNLESS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

FINISH

TITLE
SCHEMATIC DIAGRAM
1750 VA AC POWER SOURCE

ENG APPR	R Rodriguez	4/9/84	ADDITIONAL APPROVALS
PROJ ENG	[illegible]	4-9-84	
CHECK	[illegible]	4-9-84	
DESIGN			
DRAFT	R GERVAIS	4-13-84	

California Instruments
A DIVISION OF [illegible]

CONTRACT NO | CODE IDENT 16067

DWG NO 4150-099 REV C

SCALE NONE SHEET

QTY REQD | ASSIGN ON | NEXT ASSY

4150-099

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD C25 PER 5/84	5/84	
B	REVISED QIG FROM 2N2222A TO 2N6431	9/84	
C	ADDED CR20/CR21; REVISED C2 / R8	7/87	

P3

HCB FB Z — R2 390K, 1%

OSC SIG V — R5 3.74K 1% — C11 .001µF — R3 7.5K, 1% — R4 10Ω, ½Ω — C12 .001µF — CR1 1N4148 — CR2 1N4148 — U1 LF353 — C10 — A1 — -15

R1 C1 — R6 100K 1% — U2 H11F2 — C3 1µF 50V — C2 600pF — R8 80.1K 1% — R7 24K — R9 10K — C5 .47µF — A1

+15 — U3 LF353 — R11 4.75K — C4 .1µF 100V — -15

CR4 1N4148 — CR3 1N4148

REG -3 2 — REG -2 K — A1 GND U — T. OVERLOAD LAMP P — T. OVERLOAD +25V T — +BUSS 12

POSITIVE FB L — R53 330Ω

R56 2.2K 2W

VR9 IN5231A — Q9 2N5210 — R30 470Ω — R31 100K — R32 1K — C16 10µF 25V — -15

R33 1MΩ — Q10 2N2907A — R34 470Ω — R37 4.7K — VR1 IN5234 — R35 324K 1% — R38 47K — VR2 TL431C — R36 10K 1% — A — +Vc — -Vc

C7 .1µF 100V — A1

CR8 IN4004

+Vc — R44 450Ω 3¼W — Q15 TIP111 — VR7 P6KE75A — Q14 2N3822 — CR11 IN5253B — VR3 IN4148 — A

TBL15ACH — C17 1µF 50V — C18 .1µF 100V — CR20 SD103 — +15

+Vcc — -Vcc

C14 .1µF 100V — A1

R12 2.37K 1% — R14 1K 1% — Q1 2N6431 — Q2 2N6433 — C23 27PF — CR9 1N4148 — CR10 1N4148 — CR15 1N4148 — R40 26.1K, 1% — R39 14.7K 1% — C8 100PF — CR11 1N4148 — CR12 1N4148 — R13 10K 1% — Q3 2N6431 — Q4 2N6433 — Q5 2N6431 — Q6 2N6433 — R18 2.37K 1% — R19 1K 1% — R17 10K 1% — C15 .1µF 100V — A1

R16 100Ω — CR14 1N4004 — R15 220Ω — R41 10K — R20 220Ω — R21 100Ω — A

+Vc — R27 22K — Q7 2N2222A — C7 .022 — R26 100Ω — R25 22Ω — R43 100Ω CW — -Vc

CR18 1N4004 — C9 .01µF — Q8 2N2907A — R42 100Ω CW — R23 100Ω — R22 22Ω — R24 22K

+Vc — R47 22K — R55 2.2K 2W — Q17 2N6431 — R50 100Ω — R52 22Ω — R54 100Ω — R51 22Ω CW

P3 — 1 +CEL — 4 +CEL — 6 +DEV — E -DEV — 5 -CEL — 3 ØVDC — 19 — 20 — 18

+Vc — R48 400Ω 7W 5% — CR19 1N4004 — Q11 TIP112 — R46 12.1K — R45 100K — A

AGND H — A

-BUSS M — -25V B — R49 450Ω 3¼W — CR16 VR4 1N4148 — VR5 IN5253B — VR8 P6KE75A — Q12 2N3822 — Q13 TIP110 — C20 1µF 50V — 79M15CH — C19 .1µF 100V — CR21 SD103 — -15

AUX-1 Y — AUX-2 X — CR5 ME502 — R28 5.1Ω 1W — C21 470µF 100V — CR13 VR4B — R29 5.1Ω 1W — CR6 ME502 — C22 470µF 100V

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X ± .06 — BREAK ALL SHARP CORNERS & EDGES — MACH SURFACES ✓ — DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE SCHEMATIC DIAGRAM PRE AMPLIFIER

RELEASED	J. Richard	4/28/87	ADDITIONAL APPROVALS
PROJ ENG	[illegible]	4-3-84	
CHECK			
DESIGN			
DRAFT	E.E.W.	3-2-84	

California Instruments — A DIVISION OF [illegible] TECHNICAL PRODUCTS CORP., INC. SAN DIEGO CALIFORNIA

CONTRACT NO 16067

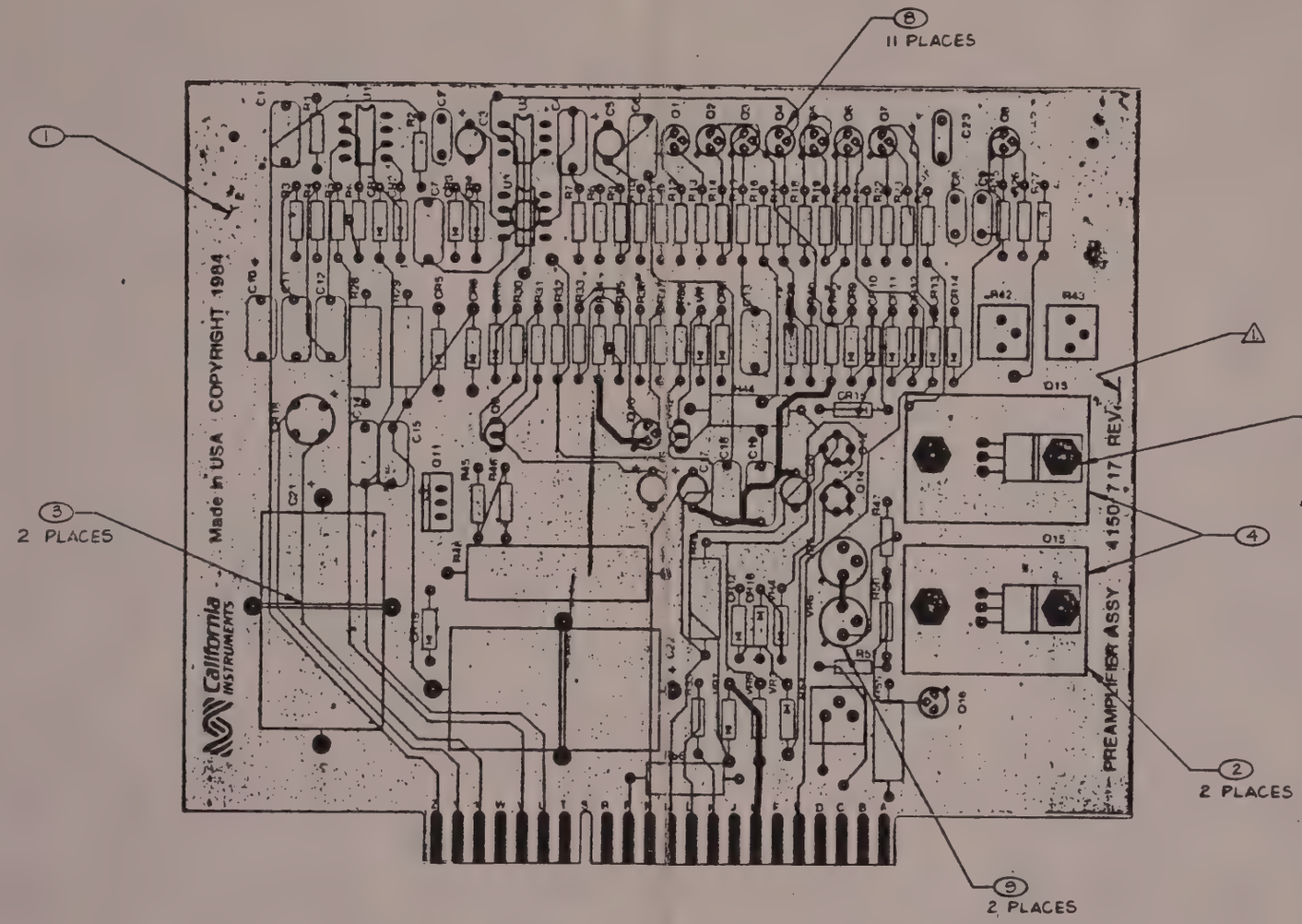
DWG NO 4150-098 REV C

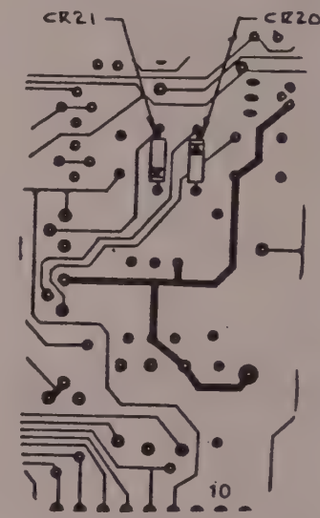
SCALE NONE SHEET 1 OF 1

QTY REQD	REF	USED ON	NEXT ASSY
-1	TS1TC-32e9	4150-717-1	

4150-098 C

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	ADD C23/REDRAWN J5 5/84	7/84	[illegible]
D	Revised Q16 from 2N2222A to 2N6431	7/84	[illegible]
E	Added CR20/CR21; Revised C17/18	8/87	[illegible]





CIRCUIT SIDE

PWB REV "B" SHOWN

FOR PARTS LIST SEE 4150-717-1

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO.

LIST OF MATERIAL

REQD PER ASSY	1	-1	QTY REQD
	ITSITC-3204	4150-422	
	USED ON	NEXT ASSY	

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .02 FRACT ± 1/32

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √

DWG SIZE D

TITLE PRINTED CIRCUIT ASSEMBLY, PREAMPLIFIER

RELEASE Richmond 7/11/84

PROJ ENG Lockard 5-2/84

CHECK ERWINE 8-10-84

DESIGN

DRAFT STANIARSKI 8/84 Kunpt 7/84

ADDITIONAL APPROVALS

California Instruments A DIVISION OF ANDREW TECHNICAL PRODUCTS CO. INC. SAN DIEGO, CALIFORNIA

CONTRACT NO 16067

DWG NO 4150-717 REV E

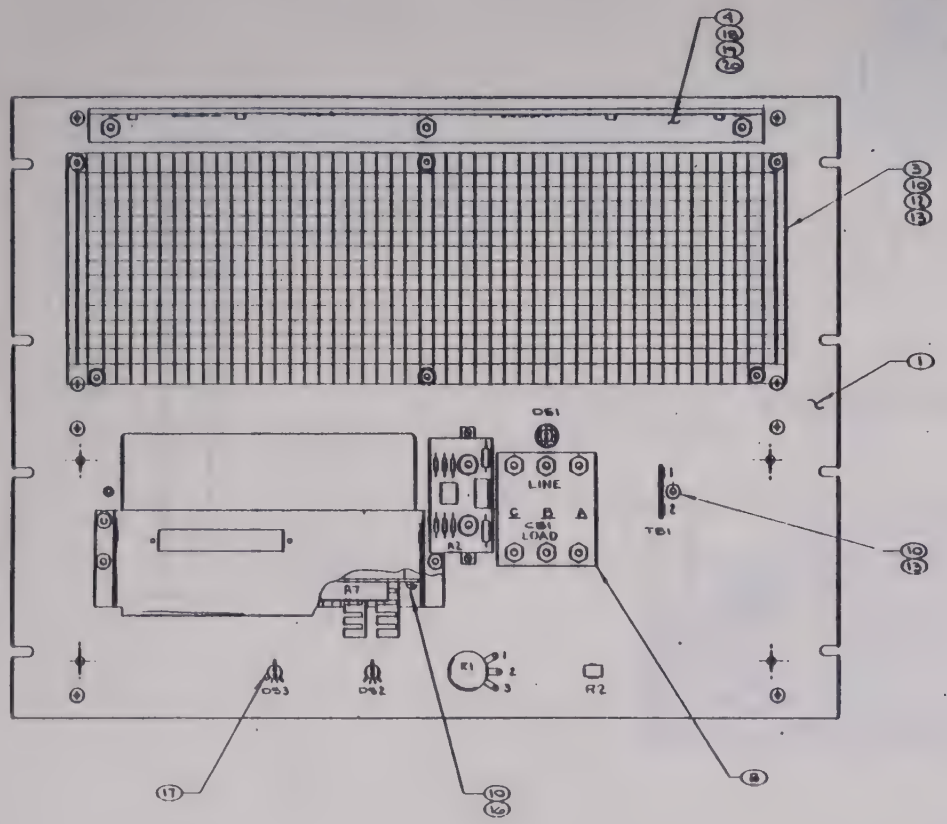
SCALE 2/1 SHEET 1 of 1

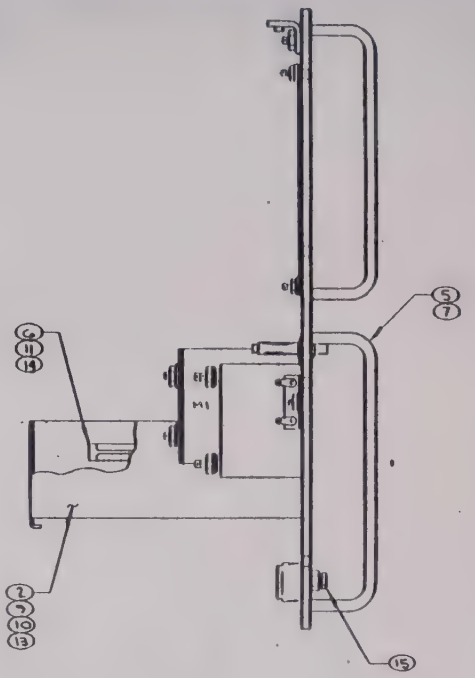
4150-717 E

2. FOR SCHEMATIC DIAGRAM SEE 4150-098
⚠ MARK WITH APPROPRIATE REVISION LETTER.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD BUBBLE NO. 8	[illegible]	[illegible]
B	REVISED CIRCUIT BREAKER	[illegible]	[illegible]





FOR PARTS LIST SEE PL 4150-444-1

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
1	1791TC-3209				

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .02 X ± .1

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE D

TITLE: FRONT PANEL ASSY

California Instruments

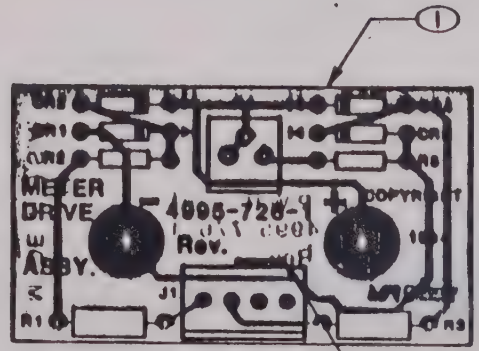
DRAWN: E.SWINK 8.11.83

DWG NO 4150-444 REV B

SCALE 3/4 SHEET 1 OF 1

NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



COMPONENT SIDE

FOR PARTS LIST SEE PL 4995-726-1

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES

DWG SIZE C

TITLE
PRINTED CIRCUIT ASSY.
METER DRIVE

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

			ADDITIONAL APPROVALS
RELEASE	R Redgrave	5/11/84	
PROJ ENG	J. Rouse	5/17/84	
CHECK			

California Instruments
A DIVISION OF AMETAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO
REV

USED	NEXT

2 MARK BLOCK WITH APPROPRIATE REV LTR

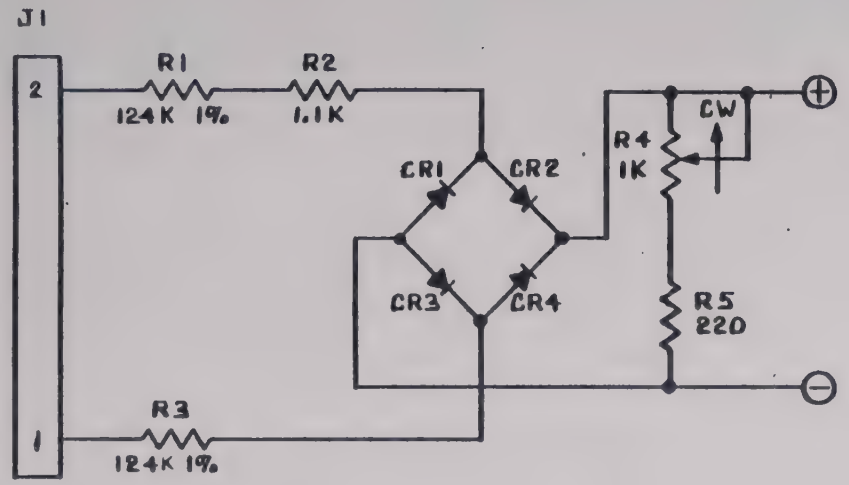
1. FOR SCHEMATIC DWG. SEE 4995-611

NOTES: (UNLESS OTHERWISE SPECIFIED)

4995-726

119-5664

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

2. ALL RESISTORS ARE ¼ WATT, 5%. RESISTANCE IS IN OHMS.

1. ALL DIODES ARE IN4148.

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES TOLERANCES
XXX = .010
XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE B

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
		751TC-3203, 1751TC-3204		
REF		4995-726-1	351TC-3202	

TITLE
SCHEMATIC
METER DRIVE PC B

MODEL 351TC-3202, 751TC-3203, 1751TC-3204

RELEASE	R. Ledyard	2/1/84				
CHECKER			PURCHASING			
DESIGN			PROJ ENGR	J. Rouse	3/17/84	
DRFTSMN	BEACH	2-84	CHF ENGR	[illegible]	3/17/84	

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. 4995-611
REV
SCALE NONE
SHEET 1 OF 1

CALICO F-101

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD C23 JS 3/64	3/64	[illegible]
B	Revised Q6 from 2N2222A to 2N6431	7/64	[illegible]
C	Added CR20/CR21; Revised C2 / R8	9/67	[illegible]

P3

HCG FB Z
OSC GIB V
REG -3 2
POSITIVE FB L
REG -2 K
A1 GND U
T. OVERLOAD LAMP P
T. OVERLOAD +25V 7
+BUSS 12
AGND H
-BUSS M
-25V B
AUX-1 Y
AUX-2 X

R2 390K, 1%
U1 LF353
R1 C1
U2 H11F2
R5 3.74K 1%
C11 .001µF
R3 7.5K, 1%
R4 102, 1/2
C12 .001µF
CR1 1N4148
CR2 1N4148
C10 .1µF
C9 1µF 50V
C2 600pF
R6 100K 1%
R8 80.1K 1%
R9 10K
C5 .47µF
U3 OP-15EJ
R11 4.75K
C4 .1µF 100V
CR4 1N4148
CR3 1N4148
R7 249K
R10 22.1K
C6 .1µF 100V
R53 330Ω
R56 2.2K 2W
R33 1MΩ
Q9 2N5210
R30 470Ω
VR9 1N5231A
R31 100K
R32 1K
C16 10µF 25V
Q10 2N2907A
R34 470Ω
R37 4.7K
VR1 1N5254
C7 .1µF 100V
R35 324K 1%
R36 10K 1%
VR2 TL431C
R38 47K
CR8 1N4004
R44 450Ω 3¼W
Q15 TIP111
VR7 P6KE75A
Q14 2N3822
CR17 1N5253B
VR3 1N4148
TBL15ACH
C17 1µF 50V
C18 .1µF 100V
CR20 SD103
R49 450Ω 3¼W
CR16 1N4148
VR4 1N5253B
VR8 P6KE75A
Q12 2N3822
Q13 TIP116
C20 1µF 50V
VR5 79M15CH
C19 .1µF 100V
CR21 SD103
CR5 MR502
R28 5.1Ω 1W
CR15 VE48
R29 5.1Ω 1W
CR6 MR502
C21 470µF 100V
C22 470µF 100V
C14 .1µF 100V
C14 .1µF 100V
R12 2.37K 1%
R19 1K 1%
Q4 2N6431
C23 27PF
Q1 2N6431
CR9 1N4148
CR10 1N4148
CR16 1N4148
R13 10K 1%
R40 26.1K, 1%
R39 14.7K 1%
C13 300PF
CR11 1N4148
CR12 1N4148
R17 10K 1%
Q2 2N6431
Q5 2N6431
R18 2.37K 1%
R19 1K 1%
C15 .1µF 100V
R16 100Ω
R15 220Ω
R41 10K
R20 220Ω
R21 100Ω
Q6 2N6431
Q7 2N2907A
CR14 1N4004
C8 .01µF
R24 22K
R27 22K
R25 22Ω
R26 100Ω
R43 100Ω CW
Q8 2N2222A
C9 .022
CR19 1N4004
R47 22K
R55 2.2K 2W
R50 100Ω
R54 100Ω
R52 CW
R51 CW
R42 100Ω CW
R23 100Ω
R22 22Ω
CR18 1N4004
C24 .01µF
R48 400Ω 7W 5%
CR13 1N4004
Q11 TIP112
R46 12.1K
R45 100K

P3
1 +CEL
4 +DRV
6 -DRV
E -CEL
5
3 ØVDC

+Vcc
-Vcc
+Vc
-Vc
A1
A

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .02 .X ± .05
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √
DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS CORP. AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE SCHEMATIC DIAGRAM PREAMPLIFIER

RELEASE	[illegible]	11/6/64	ADDITIONAL APPROVALS
PROJ ENG	[illegible]	9-3-64	
CHECK			
DESIGN			
DRAFT	ERWINE	8-20-64	

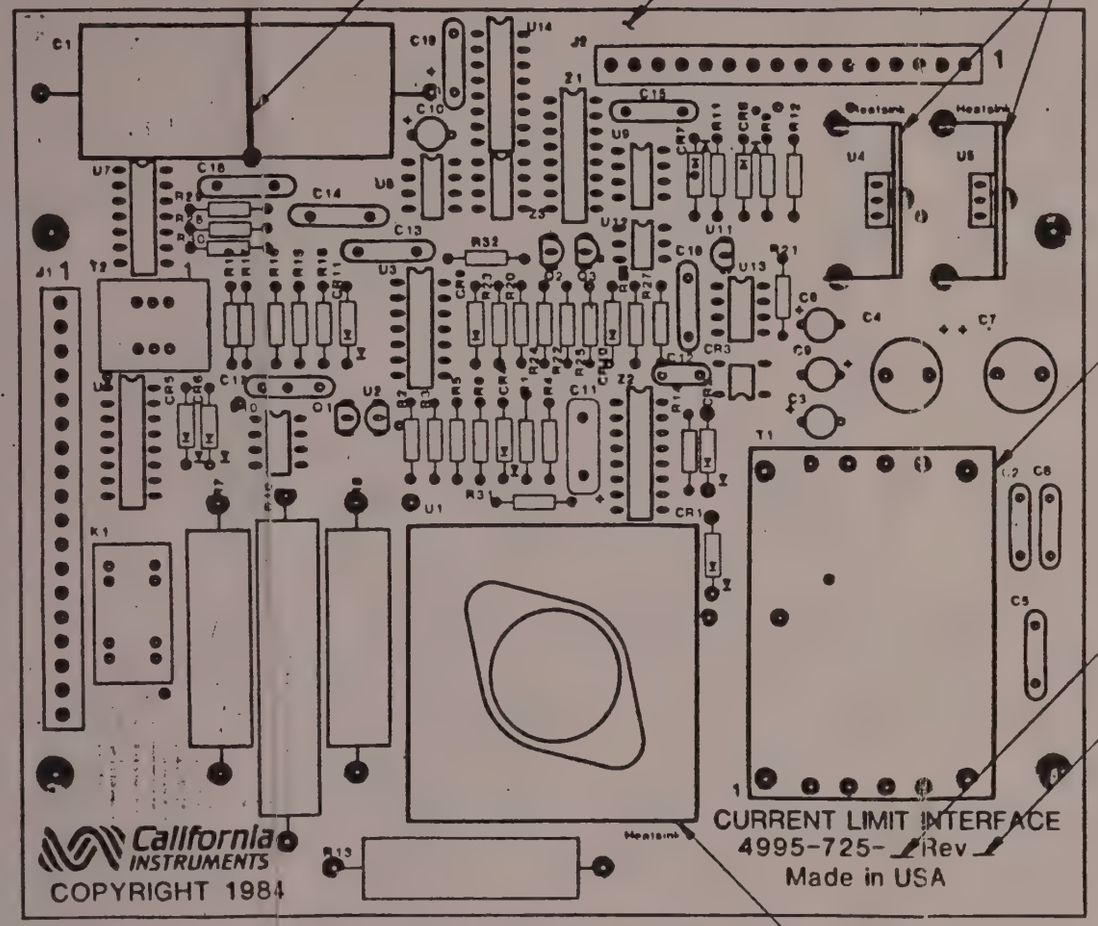
California Instruments
A DIVISION OF ABBOTT TECHNICAL PRODUCTS CO. INC. SAN DIEGO CALIFORNIA

CONTRACT NO 15067
DWG NO 4150-078 REV C
SCALE NONE SHEET 1 OF 1

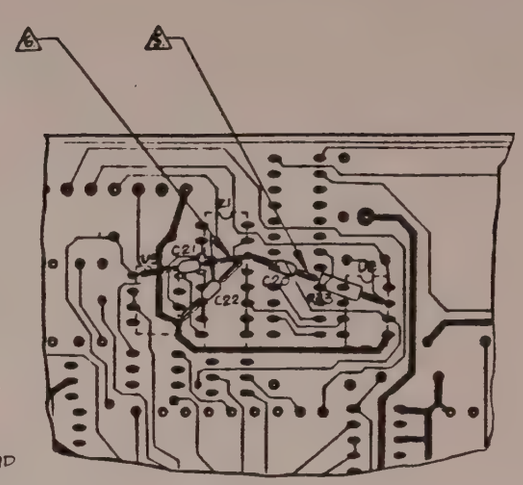
QTY REQD	USED ON	NEXT ASSY
-1	TST1TC-3209	4150-717-1

4150-078 C

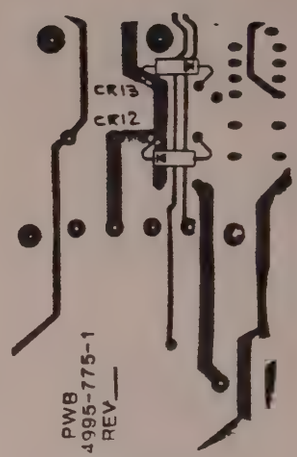
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
G	REVISED & REDRAWN. OBSOLETE PG 2		
H	ADDED CR12 & CR13, REVISED C4 & C7		



COMPONENT SIDE
REV "C" PRINTED WIRING BOARD



CIRCUIT SIDE



CIRCUIT SIDE

4 REQD

2 REQD

⚠6 SOLDER C21 BETWEEN Z1 PIN 3 AND U9 PIN 8 AS SHOWN. SOLDER C22 BETWEEN Z1 PIN 3 AND U9 PIN 4 AS SHOWN. SLEEVE LEADS ON BOTH CAPACITORS WITH STOCK NO. FS5113

⚠5 SOLDER R33 (510029) AND C20 (610054) TOGETHER. SLEEVE CONNECTING LEADS WITH HEATSHRINK TUBING (FS5001). SLEEVE OUTER LEADS (FS5113) AND SOLDER BETWEEN U8 PIN 2 AND Z1 PIN 3 TO CIRCUIT SIDE OF BOARD AS SHOWN.

4. RESISTORS R7, R8, R10 AND R13 TO BE INSTALLED WITH .18 MIN CLEARANCE FROM BOARD.

⚠3 MARK WITH APPROPRIATE REVISION LETTER.

⚠2 MARK WITH APPROPRIATE DASH NUMBER.

1. FOR SCHEMATIC SEE 4995-610.

NOTES: (UNLESS OTHERWISE SPECIFIED)

FOR PARTS LIST SEE 4995-725-1,-2 & -3

QTY REQD	USED ON	NEXT ASSY
1		175ITC-3204
	1	75ITC-3203
	1	95ITC-3202
-3	-2	-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 1° ± 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CAL (FORMA 395 TRUMBAY'S COMPANY) AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE
PRINTED CIRCUIT ASSY,
CURRENT LIMIT INTERFACE

RELEASE	J. Ledgard	11/30/95	ADDITIONAL APPROVALS
PROJ ENG			
CHECK	E.R.WINE		
DESIGN			
DRAFT	STAWIARSKI	11/29/95	

California Instruments
A DIVISION OF
SAN DIEGO, CALIFORNIA

CONTRACT NO | CODE IDENT 16067

DWG NO 4995-725 | REV H

SCALE 2/1 | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ECO 1215 JS 4/84		
B	ADD A/GND/VAR COMP CHART JS 6/84	6/84	MM RC
C	ADD R33 & C20, R14 WAS 30.9K JS 6/21/84		AK
D	ADD C21, C22		AK
E	ADDED CR12 / CR13; REVISED CAP & R VALUE	7/87	CTB

IC	TYPE	GND	+5	+15	-15
U1	LM309	3	2		
U3	74LS05	1,5,7	14		
U4	7815	2		5	
U5	7915	1			5
U6	ULN2023	8			
U7	74LS04	1,3,7	14		
U8	LF353			8	4
U9	LF412			8	4
U10	LM393	6		5,8	4
U11	TL068				2
U13	CA3193			7	4
U14	[illegible]	14,15	2	13	3

VARIABLE COMPONENTS			
REF	4995-725 ASSEMBLIES		
DES	-1	-2	-3
R7	0Ω	270Ω, 7W	400Ω, 7W
R8	0Ω	400Ω, 7W	560Ω, 7W
R10	0Ω	400Ω, 7W	400Ω, 7W
R13	0Ω	0Ω	560Ω, 7W
R21	3.3KΩ	NOT USED	NOT USED
U11	TL068	NOT USED	NOT USED

D GND J2-2, J2-1
+5V J1-14, J1-15
115 VAC HI J2-4
115V LO J2-5
A PWR GND J2-9
+15V J2-6
SRQ 1 J1-12
SRQ 2 J1-16
ELT J2-7
CURRENT TRANSFORMER HI J2-13
CURRENT TRANSFORMER LO J2-12
CL J2-15
CRL J2-11
OSCILLATOR FROM GAIN POT J2-14
OSCILLATOR TO PREAMP J2-8
A1 GND J2-10

T1, CR1 IN4004, CR2 IN4004, CR3 VM28, U1 LM309, U2 TL431C, U3 74LS05, U4 7815, U5 7915, Q1 2N2222, CR4 IN4148, CR12 SD103, CR13 SD103, K1 DIP05LP, U6 2023, U7 74LS04, U8 LF353, U9 LF412, U10 LM393, U11 TL068, U12 LM751, U13 CA3193, Q2 2N2222, Q3 2N5401, CR5 IN4148, CR6 IN4148, CR7 IN4148, CR8 IN4148, CR9 IN4148, CR10 IN4148, CR11 IN4148, U14 IH6108, T2

J1-17 PWR FLT
J1-11 R1 OUT
J1-8 RELAY DRIVE
J1-3 R2
J2-16 -15V
J1-5 R1
J1-10 R2 OUT
J1-15 CNF 1 OUT
J1-7 CNF SIGNAL OUT
J1-6 CNF
J1-9 RELAY COMMON
J1-18 CNF 2 OUT
J1-1 26 VAC LO
J1-2 26 VAC HI
J1-4 EXT SYNC

⚠ U11 NOT USED ON 4995-725-2 & -3 ASSY'S. REPLACED BY JUMPER BETWEEN PADS 1 & 3.
1. ALL CAPACITANCE IN MICROFARADS.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 .X ± .05
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √
FINISH —

	-3	-2	-1
REQ	1TSITC-3204	4995-725-3	
REQ	1TSITC-3203	4995-725-2	
REQ	3TSITC-3202	4995-725-1	
QTY REQD			
USED ON			
NEXT ASSY			

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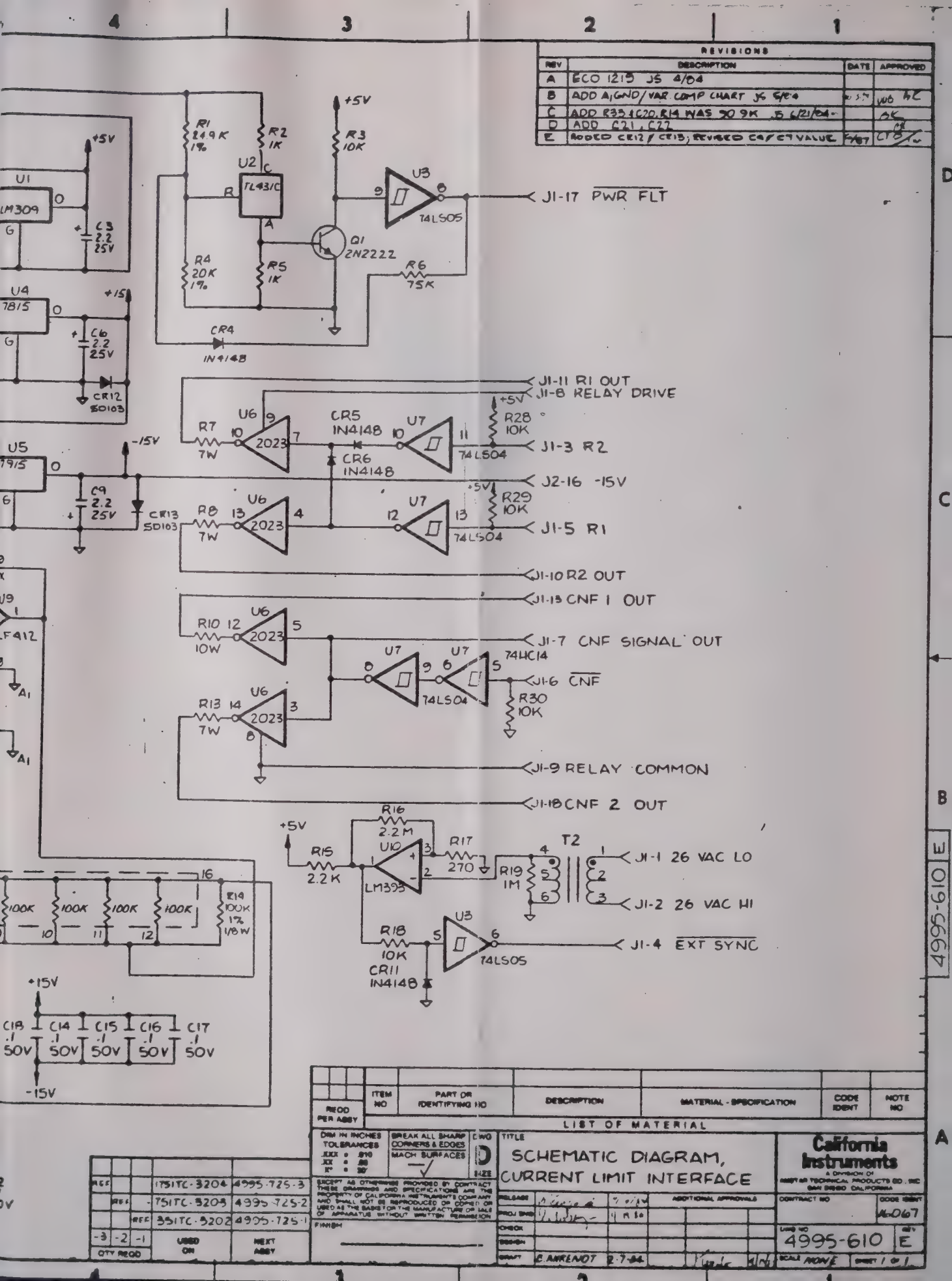
TITLE
SCHEMATIC DIAGRAM, CURRENT LIMIT INTERFACE

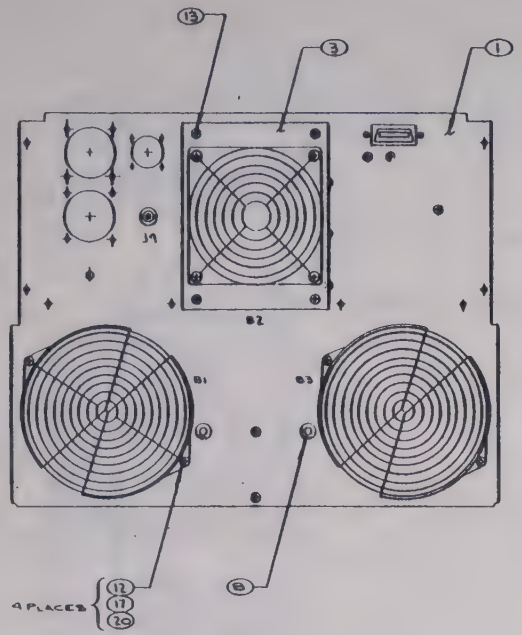
California Instruments
A DIVISION OF [illegible] SAN DIEGO, CALIFORNIA

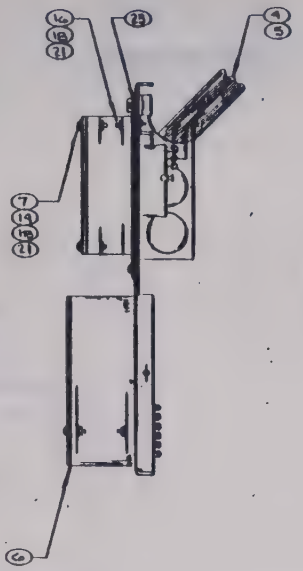
RELEASE			
PROJ ENG			
CHECK			
DESIGN			
DRAFT	C. AMRENOT	2-7-84	

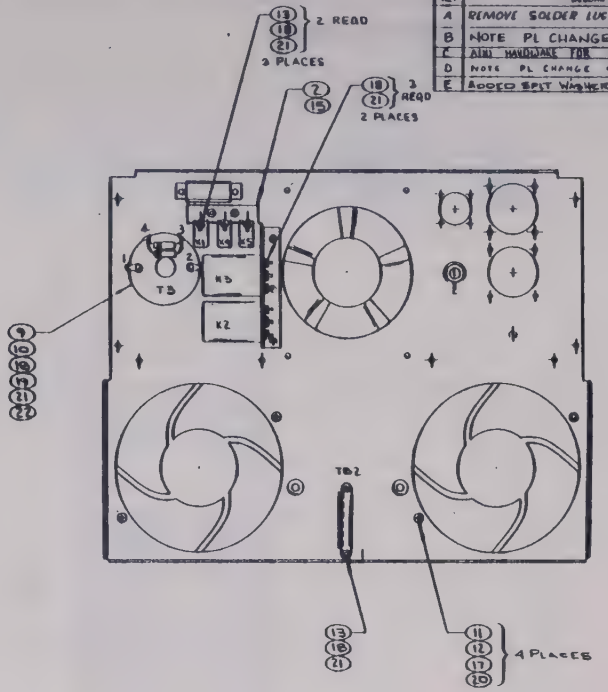
CONTRACT NO — CODE IDENT 46-067
SIZE D — DWG NO 4995-610 — REV E
SCALE NONE — SHEET 1 OF 1


REVISIONS
REV DESCRIPTION DATE APPROVED
A ECO 1213 JS 4/04
B ADD A,GND/VAR. COMP CHART JS 5/04
C ADD R35 & C20. R14 WAS 30.9K JS 6/21/04
D ADD C21, C22
E ADDED CR12 & CR13; REVISED C9 & C9 VALUE
U1 LM309
U4 7815
U5 7915
C3 2.2 25V
C6 2.2 25V
C9 2.2 25V
CR12 SD103
CR13 SD103
+5V
+15V
-15V
R1 24.9K 1%
R2 1K
R3 10K
R4 20K 1%
R5 1K
R6 75K
U2 TL431/C
Q1 2N2222
U3 74LS05
CR4 IN4148
J1-17 PWR FLT
J1-11 R1 OUT
J1-8 RELAY DRIVE
R7 7W
U6 2023
CR5 IN4148
CR6 IN4148
U7 74LS04
R28 10K
J1-3 R2
J2-16 -15V
R8 7W
R29 10K
J1-5 R1
J1-10 R2 OUT
J1-13 CNF 1 OUT
R10 10W
J1-7 CNF SIGNAL OUT
74HC14
J1-6 CNF
R30 10K
R13 7W
J1-9 RELAY COMMON
J1-18 CNF 2 OUT
R16 2.2M
R15 2.2K
U10 LM395
R17 270
T2
R19 1M
J1-1 26 VAC LO
J1-2 26 VAC HI
R18 10K
CR11 IN4148
J1-4 EXT SYNC
R14 100K 1% 1/8W
C18 .1 50V
C14 .1 50V
C15 .1 50V
C16 .1 50V
C17 .1 50V
ITEM NO
PART OR IDENTIFYING NO
DESCRIPTION
MATERIAL - SPECIFICATION
CODE IDENT
NOTE NO
REQD PER ASSY
LIST OF MATERIAL
DIM IN INCHES
TOLERANCES
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES
SIZE D
TITLE
SCHEMATIC DIAGRAM, CURRENT LIMIT INTERFACE
California Instruments
CONTRACT NO
CODE IDENT 46067
DRAWING NO 4995-610
REV E
SCALE NONE
SHEET 1 OF 1
DRAFT E.AHRENDT 2-7-84
4995-725-3 175ITC-3204
4995-725-2 75ITC-5203
4995-725-1 35ITC-5202
QTY REQD
USED ON
NEXT ASSY
4995-610 E

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	REMOVE SOLDER LUGS AND HARDWARE	5 MAY	
B	NOTE PL CHANGE 6/5/84 JS	6/6/84	
C	ADD HARDWARE FOR K1 THRU K5	7/13/84	
D	NOTE PL CHANGE 11/11/84	11/27	
E	ADDED SPLIT WASHER, ITEM 23	1/27	







NOTES (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO
1	1115176 3149	4150 442 1			
REQD PER ASSY		USED ON	NEXT ASSY		

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XX ± .010 .XXX ± .005 ANG ± 1°

BREAK ALL SHARP CORNERS EXCEPT MATCH SURFACES

QWG D SIZE

TITLE: REAR PANEL ASSY

RELEASE	Walter L	6/6/84	
NO. ITEMS	Sarah	6/6/84	
CHECK	EWHE	6/6/84	
DESIGN			
UNITS	EWHE	6/6/84	

ADDITIONAL APPROVALS

California Instruments

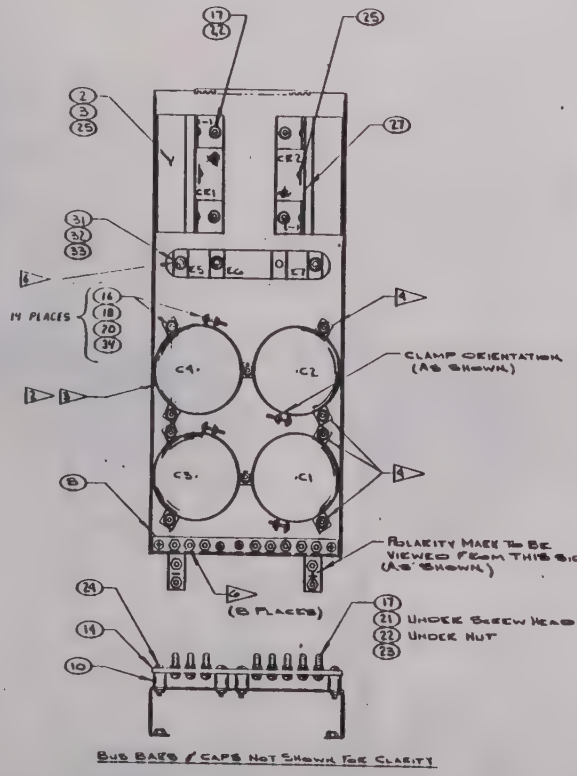
CONTRACT NO. | CODE IDENT 40067

DRG NO. 4150-442 | REV E

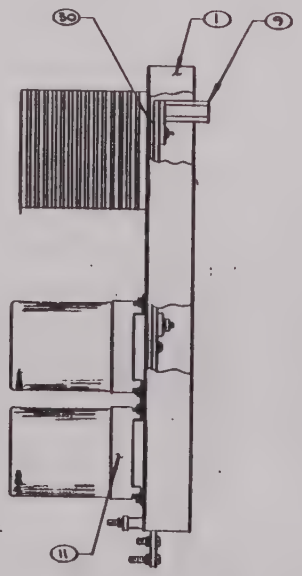
SCALE 1:1 | SHEET 1 OF 1

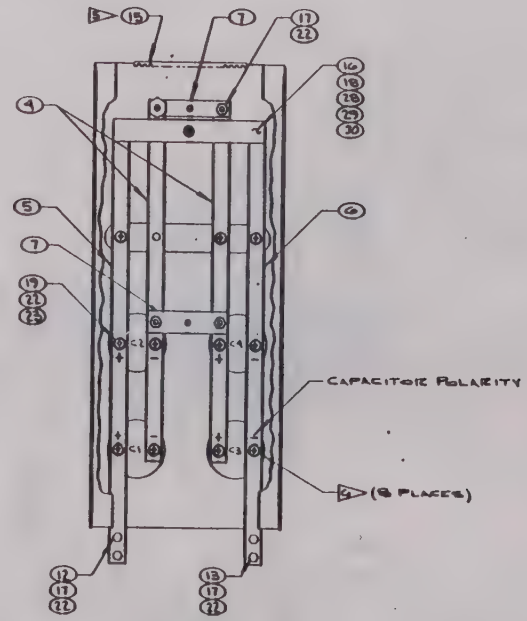
4150-442 E

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD CAPACITOR CLAMP HARDWARE	9-09-69	MR M/C
B	CHG CAPACITOR CLAMP HARDWARE ☆	9-12-69	AE



BUS BARS & CAPS NOT SHOWN FOR CLARITY





-1 FILTER ASSY

WIRE TABLE		
FROM	TO	AWG
CR1(+)	E7	2 x 12
CR1(-)	E6	2 x 12
CR2(+)	E8	2 x 12
CR2(-)	E5	2 x 12

1. APPLY "PENETROX A" AT ALL ELECTRICAL CONNECTIONS ON ALL BUS BARS
2. CENTER CATERPILLAR GROMMET TO END OF SUPPORT (ITEM 3) AS SHOWN, USE ADHESIVE
3. INSTALL C1 AND C2 NEXT, USING ONE (1) FLAT WASHER, (ITEM 18) AS SPACER BETWEEN CLAMP FOOT AND SURFACE OF SUPPORT ON ALL FEET FLAGGED
4. INSTALL C3 AND C4 FIRST WITH CAPACITOR CLAMP BEING FLUSH WITH TOP SURFACE OF SUPPORT (ITEM 1)
5. ALL CAPACITORS CANS TO BE INSTALLED FLUSH WITH TOP SURFACE OF SUPPORT (ITEM 1)

FOR PARTS LIST SEE PL 9150-445-1

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY		LIST OF MATERIAL			

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .02 X ± .06 EXCEPT AS OTHERWISE PROVIDED BY CONTRACT

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES

DWG SIZE D

TITLE FILTER ASSY

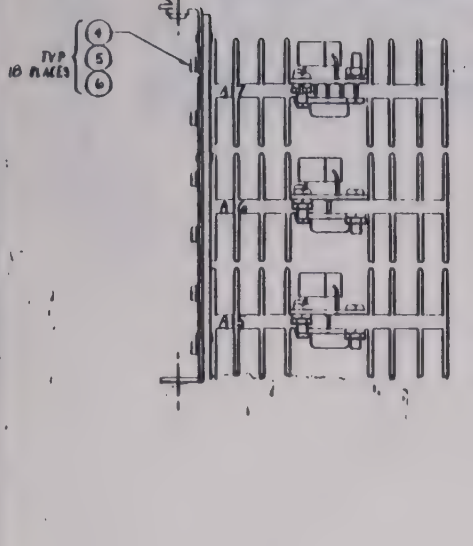
California Instruments

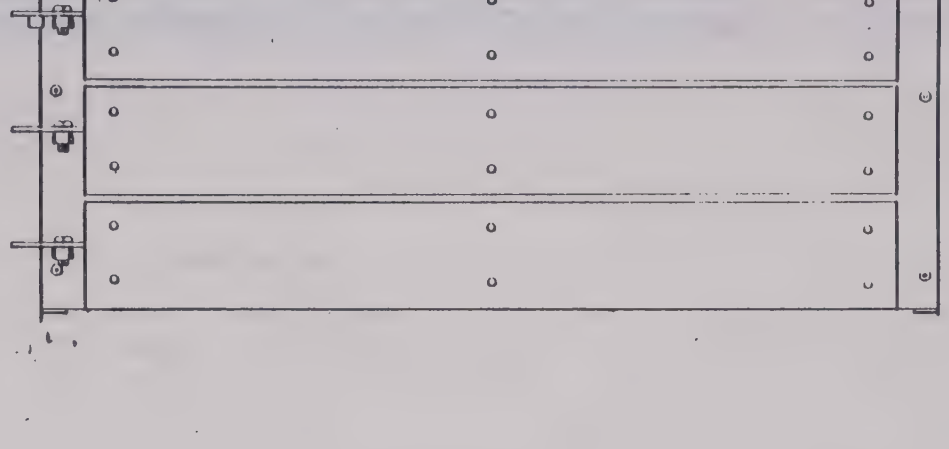
RELEASE

ADDITIONAL APPROVALS

CONTRACT NO

CODE IDENT NO





FOR PARTS LIST SEE PL 4150-440-1

ITEM NO	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	DET DWG
REQD PER ASSY						

DIM IN INCHES
TOLERANCES
XXX = .000
XX = .00
X = .0
ANGLES = 30'

BREAK ALL SHARP CORNERS & EDGES EXCEPT WHERE INDICATED

SIZE D

TITLE: MODULE ASSEMBLY, HEATSINK, NEGATIVE

MODEL 1751TG-3204

1	1	4150-442	1751TG-3204				
QTY REQ	QTY PER ASSY	DET DWG	ASSEMBLY	DASH NO			

RELEASE: Richard 3/1
CHECKED:
DESIGN:
CAD DESIGN: SanMateo
PURCHASING:
PROD ENGR:
QUAL ENGR: Kenneth
MFG:

CALICO

CONTRACT NO: 16067

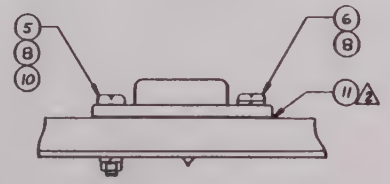
DWG NO: 4150-440

SCALE 1/1 SHEET 1 OF 1

NOTES: (UNLESS OTHERWISE SPECIFIED)

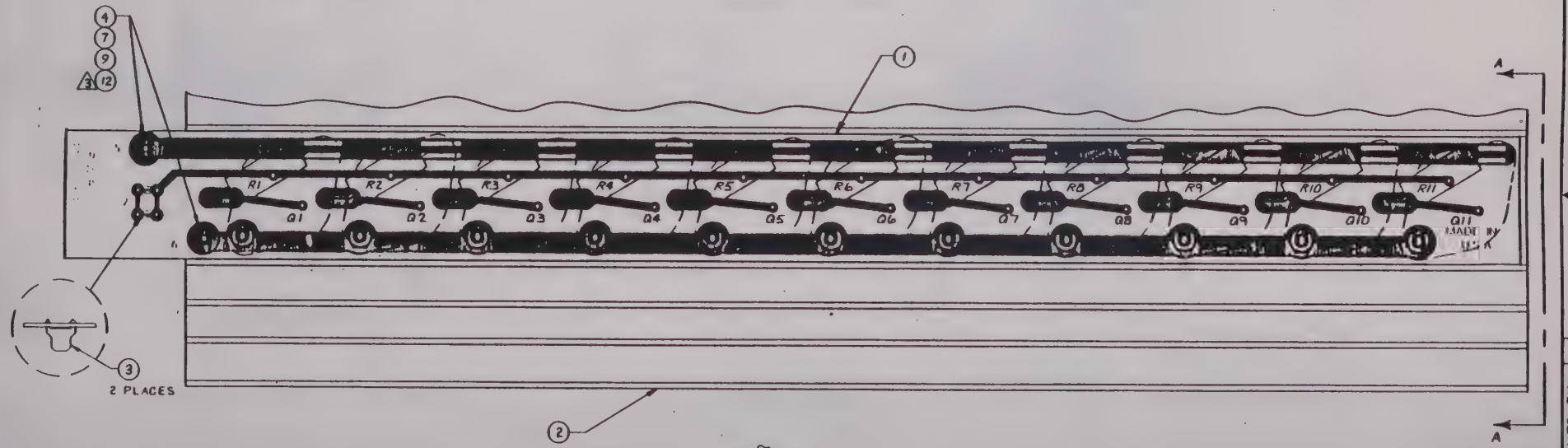
4150-440

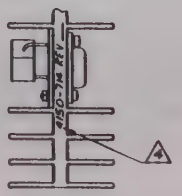
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



TRANSISTOR MOUNTING

RESISTOR MOUNTING





FOR PARTS LIST SEE PL 4150-714-1

4150-714

4 PERMANENTLY IDENTIFY HEATSINK WITH ASSY NO & REV LTR.

3 APPLY ITEM 12 IN AREA UNDER SCREW HEAD.

2 APPLY ITEM 11 BETWEEN HEATSINK AND TRANSISTOR

1. FOR SCHEMATIC SEE DWG 4150-096

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
2		1151TC-3204	4150-441-1			
2		1151TC-3204	4150-446-1			

LIST OF MATERIAL

DWG IN INCHES
TOLERANCES
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES
DWG SIZE D

TITLE: HEATSINK ASSY, PARALLEL

California Instruments
A DIVISION OF AUSTRON INCORPORATED
SAN DIEGO, CALIFORNIA

CONTRACT NO

DRAWING NO 16067

RELEASED

ADDITIONAL APPROVALS

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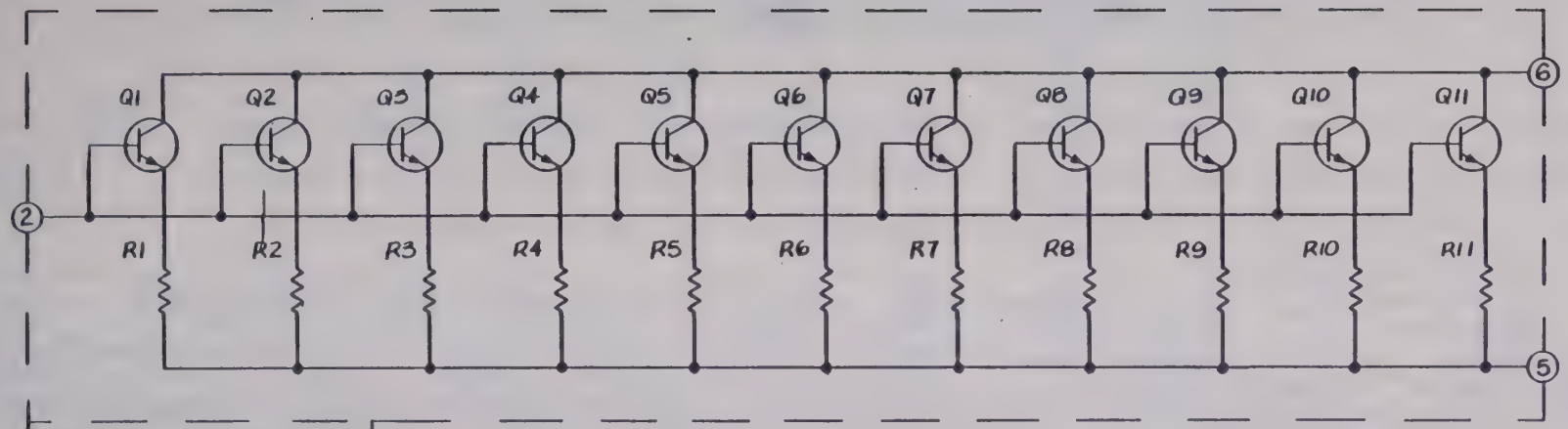


4150-714-1 (-) ASSY
4150-714-2 (+) ASSY
HEATSINK, PARALLEL

3. ALL RESISTORS FOR -2 ASSY ARE .2 Ω, 5W, 3%.
2. ALL RESISTORS FOR -1 ASSY ARE .1 Ω, 5W, 3%.
1. ALL TRANSISTORS ARE MJ15022.

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
REF	1751TC-3204	4150-714-2
REF	1751TC-3204	4150-714-1

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL · SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES —√

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE
SCHEMATIC, HEATSINK ASSEMBLY, PARALLEL

			ADDITIONAL APPROVALS
RELEASE			
PROJ ENG		4-1-84	
CHECK	ERWINE	4-11-84	
DESIGN			
DRAFT	SINHARSKI	1/84	4/5/84

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO | CODE IDENT 16067

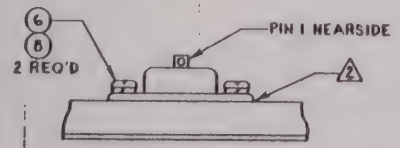
DWG NO 4150-096 | REV

SCALE NONE | SHEET 1 OF 1

4150-096

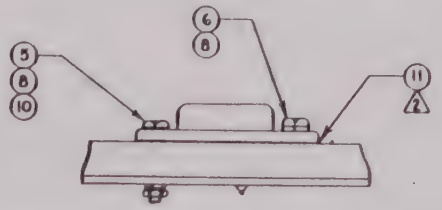
4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	SEE ECO# 1211	4 64	
B	ADD DETAIL B	6 64	
C	REVISED R2 FROM 52.3Ω TO 53.6Ω	1 65	
D	RELOCATED C1 & R2		

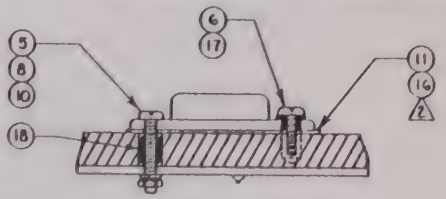


S1 MOUNTING

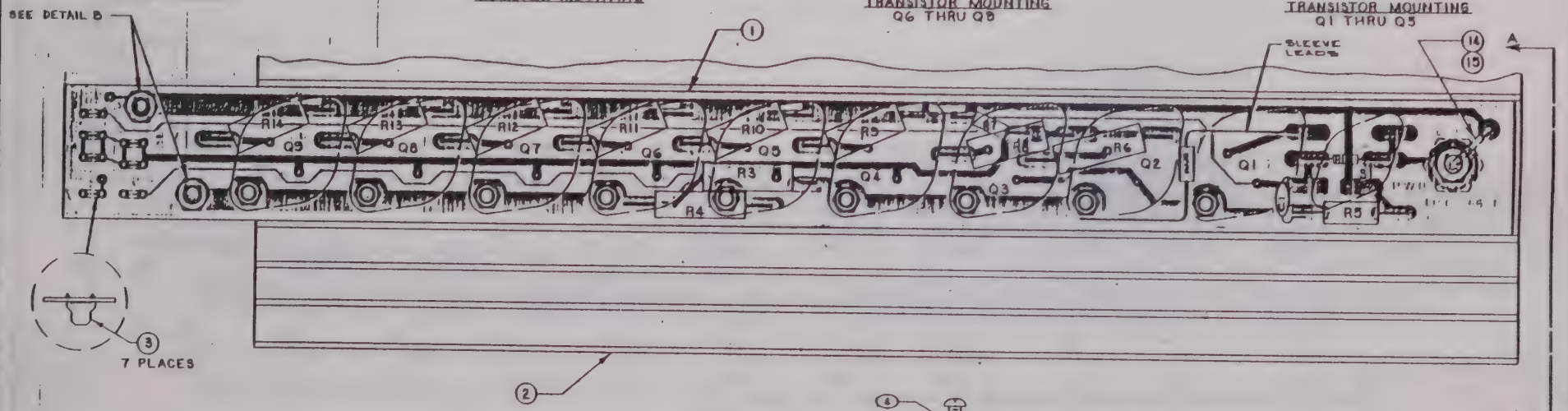
RESISTOR MOUNTING

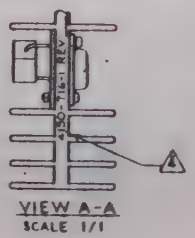


TRANSISTOR MOUNTING
Q6 THRU Q8

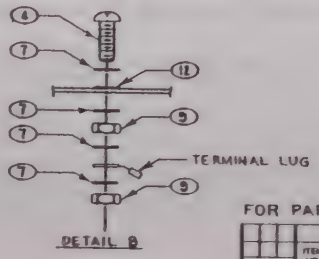


TRANSISTOR MOUNTING
Q1 THRU Q5





VIEW A-A
SCALE 1/1



DETAIL B

FOR PARTS LIST SEE PL 4150-716-1

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

4 PERMANENTLY IDENTIFY HEATSINK WITH ASSY. NO. & REV. LTR.

2. APPLY ITEM 11 BETWEEN HEATSINK AND TRANSISTOR.
1. FOR SCHEMATIC SEE DWG. 4150-097.

NOTES: (UNLESS OTHERWISE SPECIFIED)

WIRE NO	FROM	TO	REMARKS
2	S1-2	PAD 5	USE ITEM 13
1	S1-1	PAD 7	USE ITEM 13

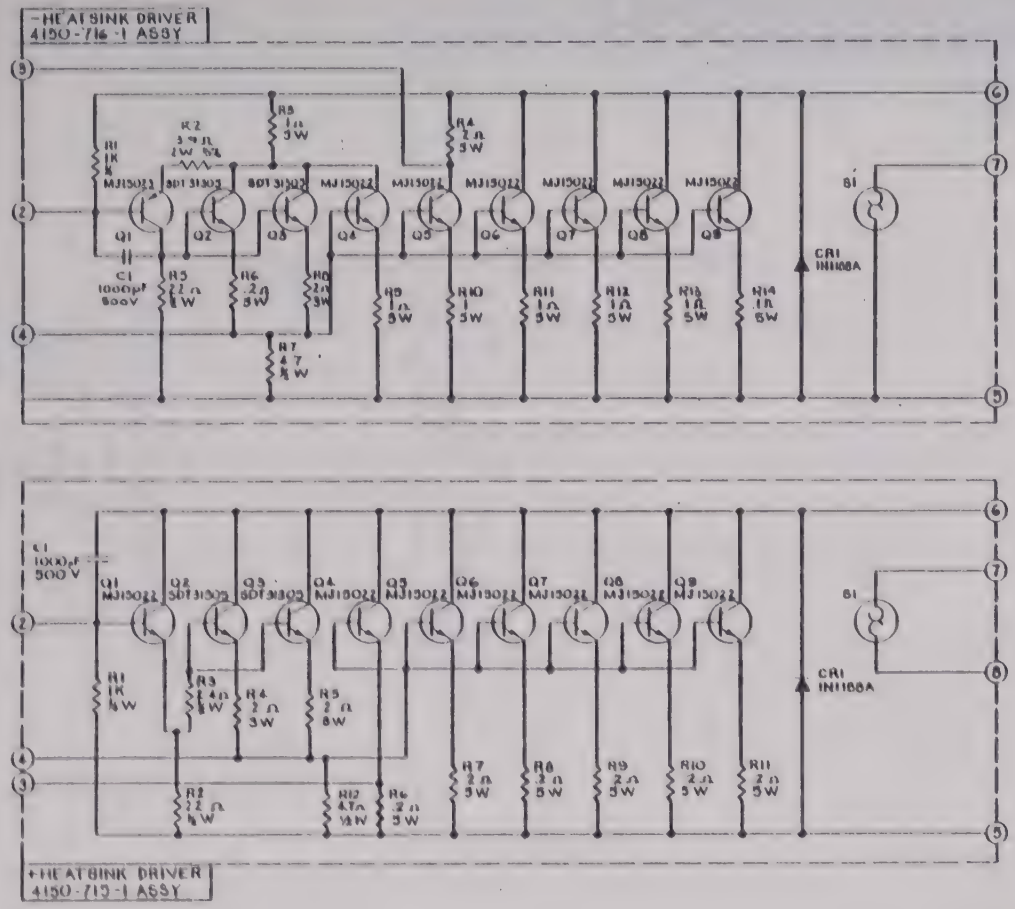
DRAWN			
TRACED			
CHECKED			
ENGR APPR			
MFG APPR			

SIZE	D
TITLE	HEATSINK ASSY, DRIVER-NEGATIVE
CONTRACT NO	
CODE IDENT	16067
DWG NO	4150-716
REV	D

California Instruments

175ITC-3204-4150-440-1

4150-716



1. ALL RESISTANCE VALUES IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED

REV	DESCRIPTION	DATE	APPROVED
A	REVISED R2 FROM 4.7Ω 1W TO 3.9Ω 2W		
B	RELOCATE C1 & R2		

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

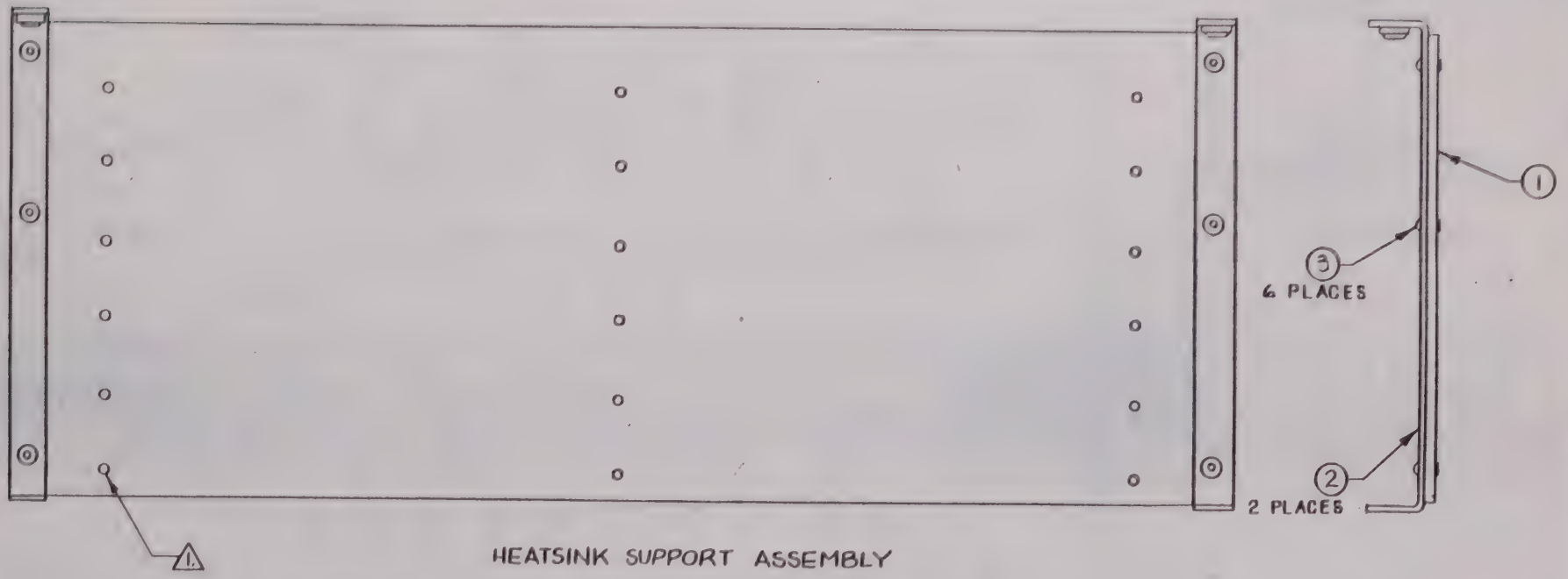
LIST OF MATERIAL

SIZE	D
TITLE	SCHEMATIC HEATSINK DRIVER
DRAWN	H. GERVAIS 4-80
CONTRACT NO	16067
DWG NO	4150 097
REV	B
SCALE	NONE
SHEET	1

California Instruments

4150-097 B

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



HEATSINK SUPPORT ASSEMBLY

FOR PARTS LIST SEE PL 4150-439-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
1		1751TC-3204		4150-441-1		
1		1751TC-3204		4150-440-1		
-1		USED		NEXT		

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE: SUPPORT ASSEMBLY, HEATSINK

			ADDITIONAL APPROVALS
RELEASE	R Belgard	4/84	
PROJ ENG	[illegible]	4/84	
CHECK			
DESIGN			

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO

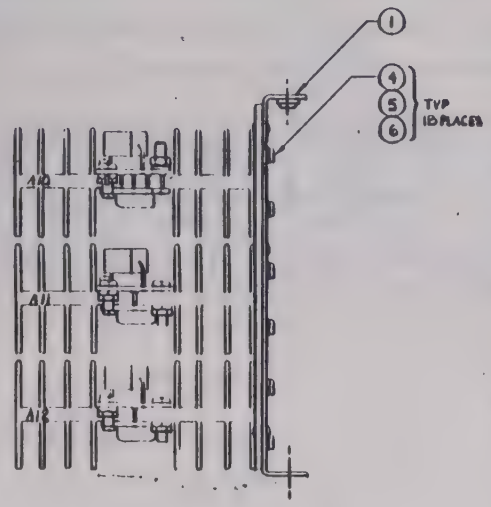
CODE IDENT 16067

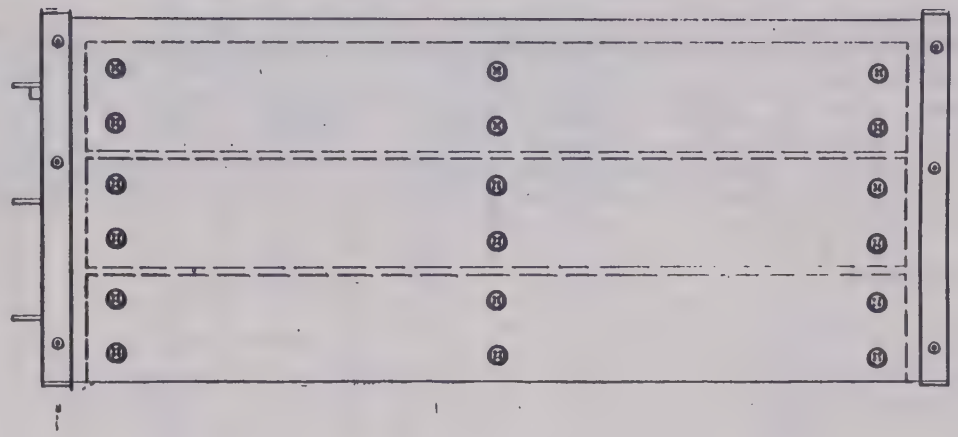
DWG NO 4150-439 REV

4150-439 B

⚠1 HOLES SPACED CLOSER TO BOTTOM EDGE THAN TOP EDGE.

NOTES: (UNLESS OTHERWISE SPECIFIED)





FOR PARTS LIST SEE PL 4150-441-1

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES
1	4150-442	1751K-320				

UNLESS OTHERWISE SPECIFIED: DIMS IN INCHES; TOLERANCES .XXX = .010, .XX = .02, .X = .1; BREAK ALL SHARP CORNERS & EDGES; SURFACE TEXTURE PER ANSI B46.1

DWG SIZE D

TITLE: MODULE ASSEMBLY, HEATSINK, POSITIVE

MODEL 1751TC-3204

RELEASE Hedgard 7/84

CHECKED

DESIGN

CONTRACT NO.

CODE IDENT 16061

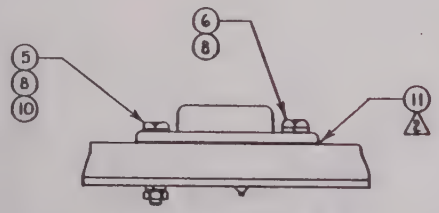
DWG NO 4150-441

SCALE 1/1

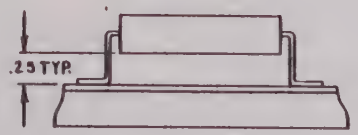
CALICO

NOTES, (UNLESS OTHERWISE SPECIFIED)

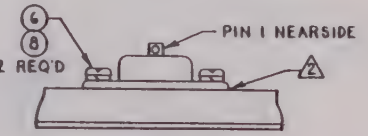
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	SEE ECO #1212.	4-64	DE
B	ADD DETAIL B	6-64	



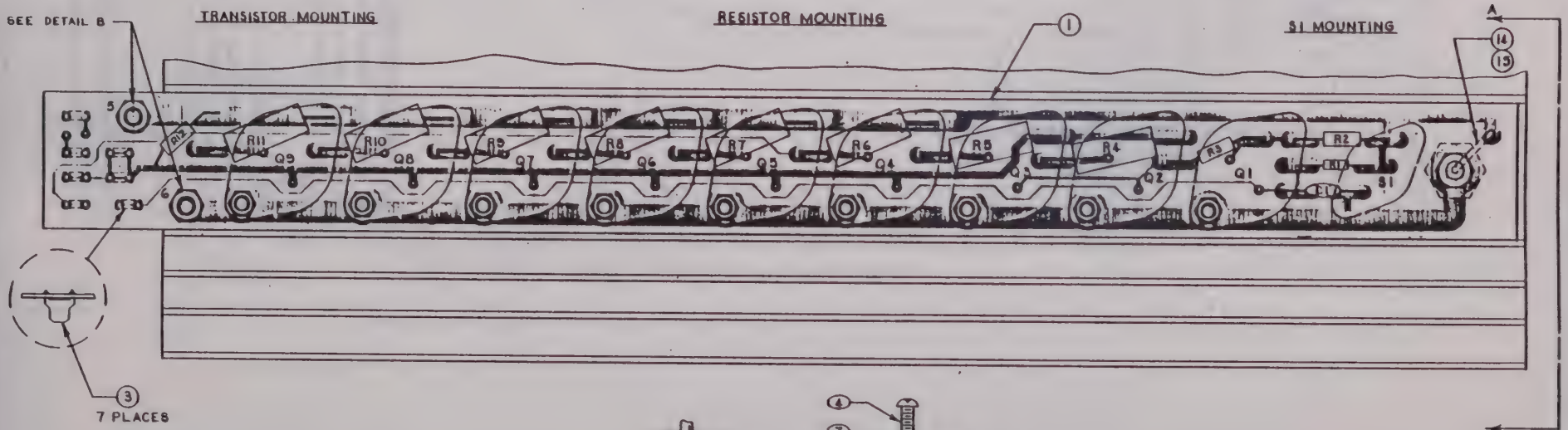
TRANSISTOR MOUNTING

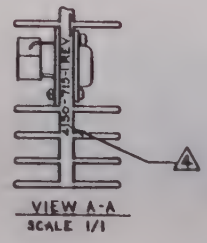


RESISTOR MOUNTING

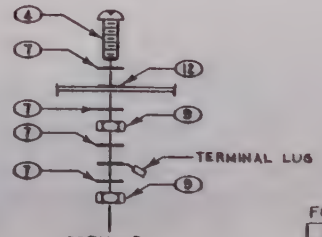


S1 MOUNTING





VIEW A-A
SCALE 1/1



DETAIL B

FOR PARTS LIST SEE PL 4150-715-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
			LIST OF MATERIAL			

DIM IN INCHES TOLERANCES .XX ± .03 .XXX ± .01 ANGLES ± 1° — BREAK ALL SHARP CORNERS & EDGES — MACH SURFACES ✓ — DWG SIZE D — FSCM NO

TITLE: HEATSINK ASSY., DRIVER - POSITIVE

California Instruments

CONTRACT NO — CODE IDENT 16067

4150-715 B

4 PERMANENTLY IDENTIFY HEATSINK WITH ASSY NO. & REV LTR.

2. APPLY ITEM 11 BETWEEN HEATSINK AND TRANSISTOR
1. FOR SCHEMATIC SEE DWG. 4150-097.

NOTES (UNLESS OTHERWISE SPECIFIED)

WIRE NO	FROM	TO	REMARKS
2	S1-2	PAD-8	USE ITEM 13
1	S1-1	PAD-7	USE ITEM 13

LTR TR-329-4150-441-1

SECTION VII

REPLACEABLE PARTS

7.1 GENERAL

This section contains ordering information and a complete list of replaceable parts. The parts are listed by their major assembly in alpha-numeric order by their reference designators. The list includes the parts description, manufacturers' identification (see Appendix A for list of manufactureres), and California Instruments' part numbers.

7.2 ORDERING INFORMATION

In order to ensure prompt, accurate service, please provide the following information, when applicable, for each replacement part ordered.

a. Model number and serial number of the instrument.

b. California Instruments part number for the sub-assembly where component is located (PARENT ITEM NO.).

c. Component reference designator (SEQ NO.).

d. Component description (DESCRIPTION TRUNCATED).

e. Component manufacturer`s FSCM number (VENDOR).

f. California Instruments part number (COMPONENT ITEM NO.).

A further explanation of these terms can be found in Section 7.3.

All replacement part orders should be addressed to:

California Instruments
Attention: Parts Department
5150 Convoy Street
San Diego, California 92111-1266

7.3 COMPUTER GENERATED PARTS LISTS

The following information is included as an explanation of the computer formatted parts list column.

7.3.1 "SEQ NO." - Sequence Number: the reference designator or the component, or (if there is no reference designator) the balloon number (bubble or "find" number) on the face of the assembly drawing or the top assembly drawing. They are listed in alpha-numeric order.

7.3.2 "COMPONENT ITEM NO." - This is California Instruments' part number. Please use this number when ordering spares or replacements.

7.3.3 "DESCRIPTION TRUNCATED" - A brief description of the item. The abbreviations are per MIL-STD-12 or industry accepted standards.

7.3.4 "ENGINEERING DRAWING NUMBER" - This is used for one of the following:

a. The document/specification number generated the California Instruments to control the part.

b. The generic part number (military specifications or industry accepted standard).

c. The primary vendor's catalog part number. An asterisk at the end of the number indicates number is longer than that shown. (Contact California Instruments if the full number is required.)

7.3.5 "VENDOR" - This is the FSCM code to identify the manufacturer. (See Appendix A).

7.3.6 "QTY" - This is the Quantity and Unit of Measure used in the assembly. The Unit of Measure abbreviations are per MIL-STD-12 or industry accepted standard.

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
	4150-060-0	HARNESS ASSY,JUMPER	4150-060 REV A	16067	1.0	EA
	4150-060-1	HARNESS ASSY	4150-060 REV D	16067	1.0	EA
	4150-060-2	HARNESS ASSY	4150-060 REV D	16067	1.0	EA
A1	4150-717-1	PC ASSY,PREAMP	4150-717 REV E	16067	1.0	EA
C5	611146	CAP,MYLAR,.22UF,250V	712A1GG224PK25*	80031	1.0	EA
C6	611146	CAP,MYLAR,.22UF,250V	712A1GG224PK25*	80031	1.0	EA
C7	611146	CAP,MYLAR,.22UF,250V	712A1GG224PK25*	80031	1.0	EA
C8	611146	CAP,MYLAR,.22UF,250V	712A1GG224PK25*	80031	1.0	EA
R3	550008	RES,PWR,3W,5.1 OHM,1%	RS-2B-5.1 OHM	91637	1.0	EA
R4	550008	RES,PWR,3W,5.1 OHM,1%	RS-2B-5.1 OHM	91637	1.0	EA
R5	550008	RES,PWR,3W,5.1 OHM,1%	RS-2B-5.1 OHM	91637	1.0	EA
R6	550008	RES,PWR,3W,5.1 OHM,1%	RS-2B-5.1 OHM	91637	1.0	EA
TB4	250132	TERMINAL STRP, 3TERM,1MT	857	83330	1.0	EA
TB5	250072	TERMINAL BLK, 3TERM,15A	599-3	75382	1.0	EA
TB6	250072	TERMINAL BLK, 3TERM,15A	599-3	75382	1.0	EA
TB7	250403	TERMINAL BLK, 4TERM,30A	602-4	75382	1.0	EA
T1	4150-016-1	TRANSFORMER,INPUT	4150-016 REV	16067	1.0	EA
T2	4150-015-1	TRANSFORMER,OUTPUT	4150-015 REV	16067	1.0	EA
1	4150-444-1	FRONT PANEL ASSY	4150-444 REV B	16067	1.0	EA
2	4150-443-1	REAR PANEL ASSY	4150-443 REV E	16067	1.0	EA
3	4150-445-1	RECTIFIER / FILTER ASSY	4150-445 REV C	16067	1.0	EA
4	4150-440-1	MODULE ASSY,H/S,NEG	4150-440 REV	16067	1.0	EA
5	4150-441-1	MODULE ASSY,H/S,POS	4150-441 REV	16067	1.0	EA
6	4150-250-1	ENCLOSURE	4150-250-1	16067	1.0	EA
7	4150-251-1	SUPPORT,MTG,PWB	4150-251-1	16067	1.0	EA
8	4150-245-1	COVER,TOP	4150-245-1	16067	1.0	EA
9	4150-246-1	COVER,BOTTOM	4150-246-1	16067	1.0	EA
10	FS4002	ADHESIVE/SEALANT,SIL,BLK	RTV-103	01139	.1	OZ
11	210835	STANDOFF,4-40 X 3/8	8402	83330	2.0	EA
12	FS1163	SCREW,CTG,PNH,6-20X3/8	MS51861-24	96906	2.0	EA
13	210767	SUPPORT,PC MTG	3929	83330	2.0	EA
14	FS1165	BOLT,HEX,S/S,1/4-20X1/2	MS35307-303	96906	12.0	EA
15	FS1173	WASHER,SPLT,1/4	MS35338-139	96906	13.0	EA
16	FS1161	WASHER,FLAT,S/S,1/4	MS15795-809	96906	8.0	EA
17	FS1167	NUT,HEX,S/S,1/4-20	MS35649-2254	96906	1.0	EA
18	FS1013	SCREW,PNH,S/S,4-40X3/8	MS51957-15	96906	4.0	EA
19	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	96906	2.0	EA
20	FS1090	SCREW,FLH,S/S,4-40X7/8	MS24693-C9	96906	2.0	EA
21	FS1026	SCREW,PNH,S/S,6-32X1/4	MS51957-26	96906	12.0	EA
22	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	21.0	EA
23	FS1034	SCREW,PNH,S/S,6-32X5/8	MS51957-31	96906	4.0	EA
24	FS1027	SCREW,FLH,S/S,6-32X1/4	MS24693-C24	96906	14.0	EA
25	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	96906	2.0	EA
26	FS1042	SCREW,PNH,S/S,8-32X3/8	MS51957-43	96906	8.0	EA
27	FS1059	SCREW,PNH,S/S,10-32X5/8	MS51958-64	96906	8.0	EA
28	FS1061	SCREW,FLH,S/S,10-32X1/2	MS24693-C272	96906	4.0	EA
29	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	7.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
30	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	18.0	EA
31	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	16.0	EA
32	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	1.0	EA
33	FS1074	WASHER,SPLT,S/S,#8	MS35338-137	96906	8.0	EA
34	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	32.0	EA
35	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	8.0	EA
36	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	14.0	EA
37	FS1067	NUT,HEX,S/S,10-32	MS35650-304	96906	28.0	EA
38	FS1164	BOLT,HEX,S/S,10-32X1/2	MS9489-06	96906	8.0	EA
39	210461	BOLT,HEX,S/S,10-32X5/8	MS9489-08	96906	2.0	EA
40	250404	JUMPER,TERMINAL BLOCK	602J	75382	1.0	EA
41	FS1062	SCREW,PNH,S/S,10-32X3/4	MS51958-65	96906	4.0	EA
42	FS4005	NOMEX,.010 THK,NATURAL	NOMEX,.010 THK	81349	320.0	SI
43	FS3001	GROMMET,STRIP,.085	CSG-09-BLACK	95987	3.0	IN

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
J2	410358	CONN,RCPT,26 SOCKET	MS3102A-28-12S	96906	1.0	EA
J5	410357	CONN,RCPT,26 SOCKET	MS3102A-28-12SX	96906	1.0	EA
J10	410158	CONN,PC EDGE,18 PIN	8BD18S-0	81312	1.0	EA
J11	410151	CONN,PC EDGE,22 PIN,POL	8BD22S-15	81312	1.0	EA
P13	410324	CONN,PC HSG,18 PIN	09-50-3181	27264	1.0	EA
P14	410351	CONN,PC HSG,16 PIN	09-50-3161	27264	1.0	EA
P15	410291	CONN,PC HSG,4 PIN	09-50-3041	27264	1.0	EA
XDS2	250078	SOCKET,LAMP	Q-082-2K	03797	1.0	EA
XDS3	250078	SOCKET,LAMP	Q-082-2K	03797	1.0	EA
1	410293	TERMINAL,CRIMP	08-56-0105	27264	33.0	EA
2	FS2012	LUG,RING,CRIMP,12/10-10	R4170F	14726	10.0	EA
3	FS2005	LUG,RING,CRIMP,16/14-10	R4161F	14726	8.0	EA
4	FS2001	LUG,RING,CRIMP,22/18-10	R4149SF	14726	2.0	EA
5	FS2002	LUG,RING,CRIMP,22/18-6	R4147SF	14726	4.0	EA
6	FS2007	LUG,S/O,F,CRMP,22/18-1/4	S09615SF	14726	2.0	EA

EQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
J1	410359	CONN,RCPT,5 PINS	MS3102A-18-11P	96906	1.0	EA
1	FS2012	LUG,RING,CRIMP,12/10-10	R4170F	14726	6.0	EA
2	FS2004	LUG,RING,CRIMP,12/10-6	R4183F	14726	4.0	EA
3	FS2006	LUG,RING,CRIMP,16/14-6	R61005GSF	14726	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED		ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR2	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR3	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR4	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR5	310244	DIODE,RECT,3A,200V		MR502	04713	1.0	EA
CR6	310244	DIODE,RECT,3A,200V		MR502	04713	1.0	EA
CR8	310062	DIODE,RECT,1A,400V,DO41		1N4004	81349	1.0	EA
CR9	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR10	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR11	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR12	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR13	310062	DIODE,RECT,1A,400V,DO41		1N4004	81349	1.0	EA
CR14	310062	DIODE,RECT,1A,400V,DO41		1N4004	81349	1.0	EA
CR15	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR16	310227	DIODE,SWNG,75V,.5W,D035		1N4148	81349	1.0	EA
CR17	310278	DIODE,ZNR,25V,.5W,5%		1N5253B	04713	1.0	EA
CR18	310199	BRDG,RECT,FW,1A,400V		VE48	27683	1.0	EA
CR19	310062	DIODE,RECT,1A,400V,DO41		1N4004	81349	1.0	EA
CR20	310285	DIODE,SHKY,.2A,40V		SD103A	15238	1.0	EA
CR21	310285	DIODE,SHKY,.2A,40V		SD103A	15238	1.0	EA
C1	610015	CAP,MICA,50PF,500V		DM15-500J	72136	1.0	EA
C2	610649	CAP,MICA,500PF,500V		DM15-501J	72136	1.0	EA
C3	610760	CAP,TANT,1UF,50V		T36A105M050AS	05397	1.0	EA
C4	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C5	610796	CAP,TANT,1UF,35V		T362A105M035AS	05397	1.0	EA
C6	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C7	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C8	610094	CAP,CER,.01UF,50V		CK103	71590	1.0	EA
C9	610956	CAP,MYLAR,.0022UF,250V	*	713A1BB222PK*	80031	1.0	EA
C11	611100	CAP,MYLAR,1000PF,250V		713A1BB102PK251	80031	1.0	EA
C12	611100	CAP,MYLAR,1000PF,250V		713A1BB102PK251	80031	1.0	EA
C13	610041	CAP,MICA,300PF,500V		CM05F301J03	81349	1.0	EA
C14	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C15	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C16	610738	CAP,TANT,10UF,25V		T362A106M025AS	05397	1.0	EA
C17	610760	CAP,TANT,1UF,50V		T36A105M050AS	05397	1.0	EA
C18	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C19	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C20	610760	CAP,TANT,1UF,50V		T36A105M050AS	05397	1.0	EA
C21	611099	CAP,AL,470UF,100V		SL100T470M	57640	1.0	EA
C22	611099	CAP,AL,470UF,100V		SL100T470M	57640	1.0	EA
C23	610010	CAP,MICA,27PF,500V		CM05E270J03	81349	1.0	EA
Q1	330328	TRANSISTOR,SS,NPN,T018		2N6431	04713	1.0	EA
Q2	330327	TRANSISTOR,SS,PNP,T018		2N6433	04713	1.0	EA
Q3	330328	TRANSISTOR,SS,NPN,T018		2N6431	04713	1.0	EA
Q4	330327	TRANSISTOR,SS,PNP,T018		2N6433	04713	1.0	EA
Q5	330328	TRANSISTOR,SS,NPN,T018		2N6431	04713	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	U
Q6	330327	TRANSISTOR,SS,PNP,T018	2N6433	04713	1.0	E
Q7	330330	TRANSISTOR,SS,PNP,T018	2N2907A	81349	1.0	E
Q8	330329	TRANSISTOR,SS,NPN,T018	2N2222A	81349	1.0	E
Q9	330295	TRANSISTOR,SS,NPN,TO92	2N5210	81349	1.0	E
Q10	330330	TRANSISTOR,SS,PNP,T018	2N2907A	81349	1.0	E
Q11	330331	TRANSISTOR,PWR,NPN,T0220	TIP112	01295	1.0	E
Q12	330319	TRANSISTOR,FET,N,JFET	2N3822	81349	1.0	E
Q13	330313	TRANSISTOR,PWR,PNP,TO220	TIP116	01295	1.0	E
Q14	330319	TRANSISTOR,FET,N,JFET	2N3822	81349	1.0	E
Q15	330312	TRANSISTOR,PWR,NPN,TO220	TIP111	01295	1.0	E
Q16	330328	TRANSISTOR,SS,NPN,T018	2N6431	04713	1.0	E
R1	510115	RES,CARB,1/4W,470K OHM	RC07GF474J	81349	1.0	E
R2	560719	RES,FILM,1/8W,590K,1%	RN55C593F	81349	1.0	E
R3	560503	RES,FILM,1/4W,7.5K,1%	RN60C7501F	81349	1.0	E
R4	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	E
R5	560811	RES,FILM,1/4W,3.74K,1%	RN60C3741F	81349	1.0	E
R6	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	E
R7	560794	RES,FILM,1/8W,249K,1%	RN55D2493F	81349	1.0	E
R8	560791	RES,FILM,1/8W,30.1K,1%	RN55D3012F	81349	1.0	E
R9	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R10	560766	RES,FILM,1/8W,22.1K,1%	RN55C2212F	81349	1.0	E
R11	560752	RES,FILM,1/8W,4.75K,1%	RN55C4751F	81349	1.0	E
R12	560759	RES,FILM,1/8W,2.37K,1%	RN55C2371F	81349	1.0	E
R13	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	E
R14	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	E
R15	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	E
R16	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
R17	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	E
R18	560759	RES,FILM,1/8W,2.37K,1%	RN55C2371F	81349	1.0	E
R19	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	E
R20	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	E
R21	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
R22	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	E
R23	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
R24	510084	RES,CARB,1/4W,22K OHM	RC07GF223J	81349	1.0	E
R25	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	E
R26	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
R27	510084	RES,CARB,1/4W,22K OHM	RC07GF223J	81349	1.0	E
R28	530050	RES,CARB,1W,5.1 OHM	RC32GF5R1J	81349	1.0	E
R29	530050	RES,CARB,1W,5.1 OHM	RC32GF5R1J	81349	1.0	E
R30	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	E
R31	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	E
R32	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	E
R33	510123	RES,CARB,1/4W,1M OHM	RC07GF105J	81349	1.0	E
R34	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	E
R35	560763	RES,FILM,1/8W,324K,1%	RN55D3243F	81349	1.0	E
R36	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	E

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R37	510068	RES,CARB,1/4W,4.7K OHM	RC07GF472J	81349	1.0	EA
R38	510092	RES,CARB,1/4W,47K OHM	RC07GF473J	81349	1.0	EA
R39	560681	RES,FILM,1/8W,14.7K,1%	RN55C1472F	81349	1.0	EA
R40	560764	RES,FILM,1/8W,26.1K,1%	RN55C2612F	81349	1.0	EA
R41	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R42	570262	POT,1T,PC,100 OHM	63P101	02111	1.0	EA
R43	570262	POT,1T,PC,100 OHM	63P101	02111	1.0	EA
R44	550212	RES,PWR,3-1/4W,450 OHM	4409A	44655	1.0	EA
R45	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R46	560756	RES,FILM,1/8W,12.1K,1%	RN55C1212F	81349	1.0	EA
R47	510084	RES,CARB,1/4W,22K OHM	RC07GF223J	81349	1.0	EA
R48	550251	RES,PWR,7W,400 OHM,5%	UT7-400 OHM-5%	81349	1.0	EA
R49	550212	RES,PWR,3-1/4W,450 OHM	4409A	44655	1.0	EA
R50	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R52	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	EA
R53	510041	RES,CARB,1/4W,330 OHM	RC07GF331J	81349	1.0	EA
R54	570262	POT,1T,PC,100 OHM	63P101	02111	1.0	EA
R55	550240	RES,PWR,2W,2.2K,5%	BWH 2.2K,5%	07716	1.0	EA
R56	550240	RES,PWR,2W,2.2K,5%	BWH 2.2K,5%	07716	1.0	EA
U1	360344	IC,OP-AMP,FET,DUAL	MC34002U	04713	1.0	EA
U2	360309	IC,OPTO,COUPLER,FET	H11F2	09214	1.0	EA
U3	360422	IC,OP-AMP,FET,PREC,HS	OP15EJ	81349	1.0	EA
VR1	310210	DIODE,ZNR,27V,.5W,10%	1N5254A	04713	1.0	EA
VR2	310269	IC,VOLTAGE REG,+VAR	TL 431 CLP	01295	1.0	EA
VR3	310227	DIODE,SWNG,75V,.5W,D035	1N4148	81349	1.0	EA
VR4	310278	DIODE,ZNR,25V,.5W,5%	1N5253B	04713	1.0	EA
VR5	360424	IC,VOLTAGE REG,+15,.5A	LM79M15CH	27014	1.0	EA
VR6	360423	IC,VOLTAGE REG,+15,.1A	LM78L15ACH	27014	1.0	EA
VR7	310277	DIODE,SUPPR,64.1VR,600W	P6KE75A	24444	1.0	EA
VR8	310277	DIODE,SUPPR,64.1VR,600W	P6KE75A	24444	1.0	EA
VR9	310143	DIODE,ZNR,5.1V,.5W,10%	1N5231A	04713	1.0	EA
1	4150-767-1	PWB,PRE-AMPLIFIER	4150-767-1	16067	1.0	EA
2	210737	HEATSINK,TO220	LAE66A2CB	98978	2.0	EA
3	FS3009	WIRE TIE,31/2	WRN-31/2	51705	2.0	EA
4	FS4001	THERMAL COMPOUND	351	13103	1.0	OZ
5	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	4.0	EA
6	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	4.0	EA
7	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	4.0	EA
8	240297	SOCKET,XSTR,TO-18	RCTO18110-1A	19080	11.0	EA
9	240296	SOCKET,XSTR,TO-5	RCTO5075-7A	19080	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
A2	4995-726-1	PC ASSY,METER DRIVE	4995-726 REV 0	16067	1.0	EA
A7	4995-725-3	PC ASSY,CUR LIMIT INTFC	4995-725 REV H	16067	1.0	EA
CB1	270129	CIRCUIT BREAKER,20A,250V	UPL111-1-65-203	81541	1.0	EA
DS1	241021	LAMP,GAS,AMBER,120V	BG03ACSNE2H/33K	03797	1.0	EA
DS2	250390	LAMP,LED,RED	CD93-RCB-0510	03797	1.0	EA
DS3	250390	LAMP,LED,RED	CD93-RCB-0510	03797	1.0	EA
M1	250401	METER,AC,ANLG,VLT,0-300	50-282113FAFA	03508	1.0	EA
R1	570128	POT,PNL,10K,1/2W,PREC	B4010-012-1	16067	1.0	EA
R2	570101	POT,MT,PC,500 OHM,3/4W	78PR500	73138	1.0	EA
TB1	250052	TERMINAL STRP, 2TERM,1MT	863	83330	1.0	EA
1	4150-247-1	PANEL,FRONT W/4150-247	4150-247-1	16067	1.0	EA
2	4035-216-1	BRACKET,PLUG-IN,OSC	4035-216-1	16067	1.0	EA
3	4150-248-1	SCREEN	4150-248-1	16067	1.0	EA
4	110194	SUPPORT,COVER	4100-218-1	16067	1.0	EA
5	240224	HANDLE,FLT,STEEL,6"	11520-S-0832-4	06540	4.0	EA
6	241124	GUIDE,PWB,4.15"	33-9016-12-01-*	91662	2.0	EA
7	FS1046	SCREW,FLH,S/S,8-32X5/8	MS24693-C51	96906	8.0	EA
8	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	96906	6.0	EA
9	FS1039	SCREW,FLH,S/S,6-32X1/2	MS24693-C28	96906	4.0	EA
10	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	15.0	EA
11	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	4.0	EA
12	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	6.0	EA
13	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	11.0	EA
14	FS1024	SCREW,PNH,S/S,6-32X3/16	MS51957-25	96906	4.0	EA
15	240209	SHAFT LOCK	181	83330	1.0	EA
16	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	4.0	EA
17	250077	MTG CLIP,LAMP	Q-081-905	03797	2.0	EA
18	FS1060	SCREW,FLH,S/S,10-32X5/8	MS24693-C273	96906	3.0	EA
19	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	3.0	EA
20	FS1067	NUT,HEX,S/S,10-32	MS35650-304	96906	3.0	EA
21	241067	POT MOUNT KIT - MODEL 56	56BW	73138	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310227	DIODE,SWNG,75V,.5W,D035	1N4148	81349	1.0	EA
CR2	310227	DIODE,SWNG,75V,.5W,D035	1N4148	81349	1.0	EA
CR3	310227	DIODE,SWNG,75V,.5W,D035	1N4148	81349	1.0	EA
CR4	310227	DIODE,SWNG,75V,.5W,D035	1N4148	81349	1.0	EA
J1	410289	CONN,PC HDR,4 PIN	26-48-1045	27264	1.0	EA
R1	560435	RES,FILM,1/4W,124K,1%	RN60C1243F	81349	1.0	EA
R2	510054	RES,CARB,1/4W,1.1K OHM	RC07GF112J	81349	1.0	EA
R3	560435	RES,FILM,1/4W,124K,1%	RN60C1243F	81349	1.0	EA
R4	570261	POT,1T,PC,1K	63P102	02111	1.0	EA
R5	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
1	4995-776-1	PWB,METER DRIVE	4995-776-1	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR2	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR3	310254	BRDG,RECT,FW,1A,200V,DIP	VM28	27683	1.0	EA
CR4	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR5	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR6	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR7	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR8	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR9	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R10	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R11	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R12	310285	DIODE,SHKY,.2A,40V	SD103A	15238	1.0	EA
R13	310285	DIODE,SHKY,.2A,40V	SD103A	15238	1.0	EA
C1	611077	CAP,AL,10000UF,16V	SM16T10000	57640	1.0	EA
C2	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C3	610798	CAP,TANT,2.2UF,25V	T362B225M025AS	05397	1.0	EA
C4	611208	CAP,AL,680UF,50V	513D687M050EK4	56289	1.0	EA
C5	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C6	610798	CAP,TANT,2.2UF,25V	T362B225M025AS	05397	1.0	EA
C7	611079	CAP,AL,470UF,35V	SM35VB470	57640	1.0	EA
C8	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C9	610798	CAP,TANT,2.2UF,25V	T362B225M025AS	05397	1.0	EA
C10	610761	CAP,TANT,1UF,20V	T362A105M020AS	05397	1.0	EA
C11	610838	CAP,TANT,.39UF,35V	196D394X9035A1	56289	1.0	EA
C12	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C13	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C14	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C15	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C16	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C17	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C18	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C19	610129	CAP,CER,.1UF,50V	CK104	71590	1.0	EA
C20	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C21	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C22	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
J1	410323	CONN,PC HDR,18 PIN	26-48-1185	27264	1.0	EA
J2	410352	CONN,PC HDR,16 PIN	26-48-1165	27264	1.0	EA
K1	245171	RELAY,REED,1B	D1B05C	14908	1.0	EA
Q1	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q2	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q3	330311	TRANSISTOR,SS,PNP,TO92	2N5401	81349	1.0	EA
R1	560256	RES,FILM,1/4W,24.9K,1%	RN60C2492F	81349	1.0	EA
R2	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R3	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R4	560239	RES,FILM,1/4W,20K,1%	RN60C2002F	81349	1.0	EA
R5	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R6	510166	RES,CARB,1/4W,75K OHM	RC07GF753J	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	U
R7	550251	RES,PWR,7W,400 OHM,5%	UT7-400 OHM-5%	81349	1.0	E
R8	550249	RES,PWR, 7W,560 OHM,10%	RS-7-560 OHM	91637	1.0	E
R9	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	E
R10	550251	RES,PWR,7W,400 OHM,5%	UT7-400 OHM-5%	81349	1.0	E
R11	510130	RES,CARB,1/4W,4.7M OHM	RC07GF475J	81349	1.0	E
R12	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	E
R13	550249	RES,PWR, 7W,560 OHM,10%	RS-7-560 OHM	91637	1.0	E
R14	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	E
R15	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	E
R16	510126	RES,CARB,1/4W,2.2M OHM	RC07GF225J	81349	1.0	E
R17	510039	RES,CARB,1/4W,270 OHM	RC07GF271J	81349	1.0	E
R18	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R19	510123	RES,CARB,1/4W,1M OHM	RC07GF105J	81349	1.0	E
R20	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R22	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	E
R23	510107	RES,CARB,1/4W,200K OHM	RC07GF204J	81349	1.0	E
R24	510088	RES,CARB,1/4W,33K OHM	RC07GF333J	81349	1.0	E
R25	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	E
R26	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
R27	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R28	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R29	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R30	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R31	510068	RES,CARB,1/4W,4.7K OHM	RC07GF472J	81349	1.0	E
R32	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	E
R33	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	E
T1	710355	TRANSFORMER	MPC-Y-15W/24-BR	08779	1.0	EA
T2	710356	TRANSFORMER	SPR-4	81095	1.0	EA
U1	360007	IC,VOLTAGE REG,+5,1A	LM309K	27014	1.0	EA
U2	310269	IC,VOLTAGE REG,+VAR	TL 431 CLP	01295	1.0	EA
U3	360160	IC,TTL,INVERT,OC,HEX	SN74LS05N	81349	1.0	EA
U4	360251	IC,VOLTAGE REG,+15,1A	MC7815CT	04713	1.0	EA
U5	360252	IC,VOLTAGE REG,-15,1A	MC7915CT	04713	1.0	EA
U6	330326	TRANSISTOR,ARRAY,NPN,DIP	ULN2023A	56289	1.0	EA
U7	360347	IC,TTL,INVERT,HEX	SN74LS04J	81349	1.0	RS
U8	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U9	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U10	360219	IC,COMPARATOR,DUAL	LM393N	27014	1.0	EA
U11	FS5118	WIRE,BUS,AWG 24,QQ-W-343E	QQW343S24S2B	81348	.3	IN
U11	FS6015	TUBING,TEFLON,AWG 8	TFT-200-8-NAT.	92194	.3	IN
U12	360256	IC,OPTO,MODULATOR	CLM51	03911	1.0	EA
U13	360345	IC,OP-AMP,PREC	CA3193S	93303	1.0	EA
U14	360414	IC,ANA,MUX,8-CHANNEL	IH6108CJE	81349	1.0	EA
Z1	360384	RES,ARRAY,TFLM,DIP,100K	698-3-R100K-F	73138	1.0	EA
Z2	360204	RES,ARRAY,TFLM,DIP,100K	698-1-R100K	73138	1.0	EA
Z3	360420	RES,ARRAY,DIP,10K	694-3-R10K-D	73138	1.0	EA
1	4995-775-1	PWB,CURRENT LIMIT INTFC	4995-775-1	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
2	210759	HEATSINK,T03	689-125-B-2	05820	1.0	EA
3	210760	HEATSINK,T0220	6030B-TT	13103	2.0	EA
4	FS3009	WIRE TIE,31/2	WRN-31/2	51705	1.0	EA
5	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
6	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	8.0	EA
7	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	8.0	EA
8	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	8.0	EA
9	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	2.0	EA

EQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
B1	210055	FAN,6",115VAC,50/60HZ	76005	23936	1.0	EA
B2	241063	FAN,4",115VAC,50/60HZ	WS2107F-110	99743	1.0	EA
B3	210055	FAN,6",115VAC,50/60HZ	76005	23936	1.0	EA
J4	410091	CONN,BNC,INSULATED	28JR106-1	24931	1.0	EA
K1	245176	RELAY,POWER,2C,10A	B07D112BC4-0007	81541	1.0	EA
K2	245175	RELAY,POWER,4C,10A	5724HS4PDT	81541	1.0	EA
K3	245175	RELAY,POWER,4C,10A	5724HS4PDT	81541	1.0	EA
K4	245176	RELAY,POWER,2C,10A	B07D112BC4-0007	81541	1.0	EA
K5	245176	RELAY,POWER,2C,10A	B07D112BC4-0007	81541	1.0	EA
B2	240110	TERMINAL STRP, 6TERM,2MT	3006	83330	1.0	EA
T3	CIC601-1	CUR TRANS BURDEN RES ASSY	CIC601-1 REV 0	16067	1.0	EA
1	4150-249-1	PANEL,REAR W/4150-249	4150-249-1	16067	1.0	EA
2	4150-244-1	BRACKET,SUPPORT,RELAYS	4150-244-1	16067	1.0	EA
3	110140	BRACKET,MOUNTING,FAN	4100-214-7	16067	1.0	EA
4	4848-205-1	CABLE ASSY,GPIB(-PC)	4848-205-1	16067	1.0	EA
5	210679	JACK SOCKET,GPIB	552633-4	00779	1.0	ST
6	210074	FAN GUARD	5506	23936	2.0	EA
7	241064	FAN GUARD	550481	82877	1.0	EA
8	210173	GROMMET,RUBBER,7/16"DIA	3241	08065	2.0	EA
9	210309	BUMPER,RUBBER	2193	08065	1.0	EA
10	210762	SCREW,PNH,SS,6-32X2	MS51957-38	96906	1.0	EA
11	FS4011	ADHESIVE/SEALANT,LOCTITE	290	05972	.1	OZ
12	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	8.0	EA
13	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	12.0	EA
14	FS1037	SCREW,PNH,S/S,6-32X7/8	MS51957-33	96906	4.0	EA
15	FS1027	SCREW,FLH,S/S,6-32X1/4	MS24693-C24	96906	5.0	EA
16	FS1089	SCREW,FLH,S/S,6-32X5/8	MS24693-C29	96906	4.0	EA
17	FS1074	WASHER,SPLT,S/S,#8	MS35338-137	96906	8.0	EA
18	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	23.0	EA
19	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	1.0	EA
20	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	8.0	EA
21	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	23.0	EA
22	210146	BUMPER,RUBBER	2091	08065	1.0	EA
23	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	CIC739	BRDG,RECT,TPFW,100A,200V	CIC739	16067	1.0	EA
CR2	CIC739	BRDG,RECT,TPFW,100A,200V	CIC739	16067	1.0	EA
C1	611110	CAP,AL,32000UF,75V	CGS323U075X4C3*	90201	1.0	EA
C2	611110	CAP,AL,32000UF,75V	CGS323U075X4C3*	90201	1.0	EA
C3	611110	CAP,AL,32000UF,75V	CGS323U075X4C3*	90201	1.0	EA
C4	611110	CAP,AL,32000UF,75V	CGS323U075X4C3*	90201	1.0	EA
1	4150-243-1	SUPPORT,CAPACITOR	4150-243-1	16067	1.0	EA
2	4150-242-1	BRACKET,MOUNTING,H/S	4150-242-1	16067	2.0	EA
3	4150-241-1	HEATSINK	4150-241-1	16067	2.0	EA
4	4150-223-7	BUS BAR,CU	4150-223-7	16067	2.0	EA
5	4150-223-8	BUS BAR,CU	4150-223-8	16067	1.0	EA
6	4150-223-9	BUS BAR,CU	4150-223-9	16067	1.0	EA
7	4150-223-10	BUS BAR,CU	4150-223-10	16067	2.0	EA
8	4150-226-1	BUS BAR,CU	4150-226-1	16067	1.0	EA
9	4150-227-1	STANDOFF,10-32X1&1/2,CU	4150-227-1	16067	1.0	EA
10	210707	STANDOFF,CAPT,8-32 X 1/2	T8NY-500-NA	85480	4.0	EA
11	241052	CAP CLAMP,3"	4586-2	56289	4.0	EA
12	210461	BOLT,HEX,S/S,10-32X5/8	MS9489-08	96906	2.0	EA
13	210462	BOLT,HEX,S/S,10-32X7/8	MS9489-12	96906	2.0	EA
14	FS4012	CONDUCTING LUBE	PS8 PENETROX A	09922	.1	OZ
15	FS3000	GROMMET,STRIP,.052	CSG-06-NATURAL	95987	4.0	IN
16	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	15.0	EA
17	FS1067	NUT,HEX,S/S,10-32	MS35650-304	96906	19.0	EA
18	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	15.0	EA
19	FS1082	WASHER,FLAT,S/S,#10	MS15795-842	96906	8.0	EA
20	FS1079	WASHER,FLAT,S/S,#4	MS15795-804	96906	14.0	EA
21	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	8.0	EA
22	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	27.0	EA
23	FS1062	SCREW,PNH,S/S,10-32X3/4	MS51958-65	96906	8.0	EA
24	FS1052	SCREW,PNH,S/S,8-32X3/4	MS51957-47	96906	4.0	EA
25	FS1131	SCREW,CTG,PNH,8-18X3/8	MS51861-34	96906	10.0	EA
27	FS4001	THERMAL COMPOUND	351	13103	1.0	OZ
28	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	1.0	EA
29	4150-252-1	INSULATOR,BUS BAR	4150-252-1	16067	1.0	EA
30	4150-252-2	INSULATOR,BUS BAR	4150-252-2	16067	2.0	EA
31	FS1162	BOLT,HEX,S/S,1/4-20X3/4	MS35307-306	96906	3.0	EA
32	FS1173	WASHER,SPLT,1/4	MS35338-139	96906	3.0	EA
33	FS1167	NUT,HEX,S/S,1/4-20	MS35649-2254	96906	3.0	EA
34	FS1034	SCREW,PNH,S/S,6-32X5/8	MS51957-31	96906	14.0	EA
35	FS1059	SCREW,PNH,S/S,10-32X5/8	MS51958-64	96906	8.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
A15	4150-714-1	HEATSINK ASSY,OUT DRIVER	4150-714 REV	16067	1.0	EA
A16	4150-714-1	HEATSINK ASSY,OUT DRIVER	4150-714 REV	16067	1.0	EA
A17	4150-716-1	HEATSINK ASSY,OUT DRIVER	4150-716 REV D	16067	1.0	EA
1	4150-439-1	SUPPORT ASSY,HEATSINK	4150-439 REV	16067	1.0	EA
4	210712	SCREW,CTG,PNH,6-20X1/2	MS51861-25	96906	18.0	EA
5	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	18.0	EA
6	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	18.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
Q1	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q2	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q3	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q4	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q5	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q6	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q7	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q8	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q9	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q10	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q11	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
R1	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R2	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R3	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R4	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R5	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R6	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R7	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R8	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R9	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R10	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R11	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
1	4150-764-1	PWB,HEATSINK,OUT DRIVER	4150-764-1	16067	1.0	EA
2	4150-236-1	HEATSINK	4150-236-1	16067	1.0	EA
3	250315	TERMINAL,QCK CLP,PB,MALE	836	79963	2.0	EA
4	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	2.0	EA
5	FS1034	SCREW,PNH,S/S,6-32X5/8	MS51957-31	96906	11.0	EA
6	FS1026	SCREW,PNH,S/S,6-32X1/4	MS51957-26	96906	11.0	EA
7	FS1074	WASHER,SPLT,S/S,#8	MS35338-137	96906	2.0	EA
8	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	22.0	EA
9	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	2.0	EA
10	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	11.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
12	FS4012	CONDUCTING LUBE	PS8 PENETROX A	09922	.1	OZ

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
C1	610730	CAP,CER,1000PF,1000V	DD102	71590	1.0	EA
Q1	330315	TRANSISTOR,PWR,PNP,TO3	MJ15023	04713	1.0	EA
Q2	330316	TRANSISTOR,PWR,NPN,TO3	SDT31305	21845	1.0	EA
Q3	330316	TRANSISTOR,PWR,NPN,TO3	SDT31305	21845	1.0	EA
Q4	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q5	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q6	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q7	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q8	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q9	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
R1	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R2	550252	RES,PWR,2W,3.9 OHM,5%	BWH 3.9 OHM	07716	1.0	EA
R3	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R4	550186	RES,PWR,5W,.2 OHM,5%	RS-5-.2 OHM	91637	1.0	EA
R5	520008	RES,CARB,1/2W,22 OHM	RC20GF220J	81349	1.0	EA
R6	550203	RES,PWR,3W,.2 OHM	RW69VR20	81349	1.0	EA
R7	520126	RES,CARB,1/2W,4.7 OHM	RC20GF4R7J	81349	1.0	EA
R8	550203	RES,PWR,3W,.2 OHM	RW69VR20	81349	1.0	EA
R9	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R10	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R11	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R12	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R13	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
R14	550155	RES,PWR,5W,.1 OHM,5%	RW55GR10WL	63743	1.0	EA
S1	270066	THERMO-SWITCH	3450-87-149	14604	1.0	EA
1	4150-766-1	PWB,HEATSINK,OUT DRIVER	4150-766-1	16067	1.0	EA
2	4150-240-1	HEATSINK	4150-240-1	16067	1.0	EA
3	250315	TERMINAL,QCK CLP,PB,MALE	836	79963	7.0	EA
4	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	2.0	EA
5	FS1020	SCREW,PNH,S/S,4-40X5/8	MS51957-18	96906	9.0	EA
6	FS1011	SCREW,PNH,S/S,4-40X1/4	MS51957-13	96906	9.0	EA
7	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	8.0	EA
8	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	13.0	EA
9	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	4.0	EA
10	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	9.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
12	FS4012	CONDUCTING LUBE	PS8 PENETROX A	09922	.1	OZ
13	FS5032	WIRE,BU,AWG 20,WHT	M16878/48BGA9	81349	28.0	IN
14	FS5123	WIRE,BUS,AWG 14,QQ-W-343E	QQW343S14S2B	81348	3.0	IN
15	FS6013	TUBING,TEFLON,AWG 14	TFT-200-14-NAT.	92194	2.0	IN
16	330192	INSULATOR,MICA,TO3	DM123	08289	5.0	EA
17	210076	INSULATOR,SHLDR,NYL,#4	NY04-040	08289	5.0	EA
18	FS6016	TUBING,TEFLON,AWG 10	TFT-200-10-NAT.	92194	3.0	IN

EQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	4150-237-1	PLATE,SUPPORT,HEATSINK	4150-237-1	16067	1.0	EA
2	4150-238-1	BRACKET,MOUNTING,H/S	4150-238-1	16067	2.0	EA
3	210728	FSTNR,RVT,POP,1/8X.357	AD44ABS	07707	6.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
A10	4150-715-1	HEATSINK ASSY,OUT DRIVER	4150-715 REV B	16067	1.0	EA
A11	4150-714-2	HEATSINK ASSY,OUT DRIVER	4150-714 REV	16067	1.0	EA
A12	4150-714-2	HEATSINK ASSY,OUT DRIVER	4150-714 REV	16067	1.0	EA
1	4150-439-1	SUPPORT ASSY,HEATSINK	4150-439 REV	16067	1.0	EA
4	210712	SCREW,CTG,PNH,6-20X1/2	MS51861-25	96906	18.0	EA
5	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	18.0	EA
6	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	18.0	EA

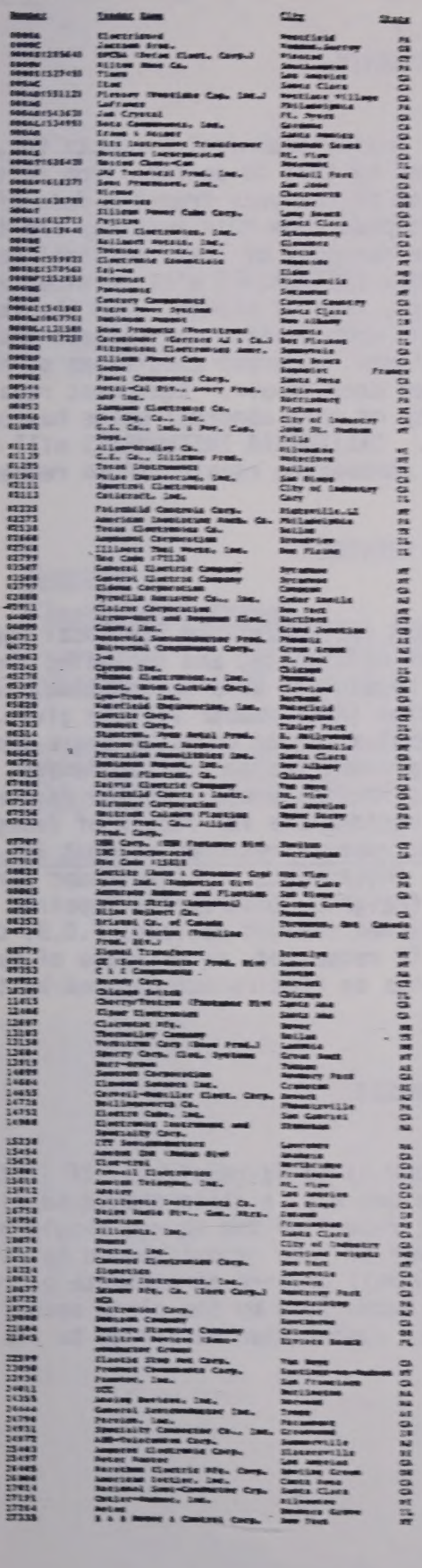
SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
C1	610543	CAP,CER,1500PF,1000V	DD152	71590	1.0	EA
Q1	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q2	330316	TRANSISTOR,PWR,NPN,TO3	SDT31305	21845	1.0	EA
Q3	330316	TRANSISTOR,PWR,NPN,TO3	SDT31305	21845	1.0	EA
Q4	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q5	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q6	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q7	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q8	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q9	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
R1	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R2	520008	RES,CARB,1/2W,22 OHM	RC20GF220J	81349	1.0	EA
R3	520132	RES,CARB,1/2W,2.4 OHM	RC20GF2R4J	81349	1.0	EA
R4	550203	RES,PWR,3W,.2 OHM	RW69VR20	81349	1.0	EA
R5	550203	RES,PWR,3W,.2 OHM	RW69VR20	81349	1.0	EA
R6	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R7	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R8	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R9	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R10	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R11	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R12	520126	RES,CARB,1/2W,4.7 OHM	RC20GF4R7J	81349	1.0	EA
S1	270066	THERMO-SWITCH	3450-87-149	14604	1.0	EA
1	4150-765-1	PWB,HEATSINK,OUT DRIVER	4150-765-1	16067	1.0	EA
2	4150-240-1	HEATSINK	4150-240-1	16067	1.0	EA
3	250315	TERMINAL,QCK CLP,PB,MALE	836	79963	7.0	EA
4	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	2.0	EA
5	FS1020	SCREW,PNH,S/S,4-40X5/8	MS51957-18	96906	9.0	EA
6	FS1011	SCREW,PNH,S/S,4-40X1/4	MS51957-13	96906	9.0	EA
7	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	8.0	EA
8	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	18.0	EA
9	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	4.0	EA
10	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	9.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
12	FS4012	CONDUCTING LUBE	PS8 PENETROX A	09922	.1	OZ
13	FS5032	WIRE,BU,AWG 20,WHT	M16878/48BGA9	81349	28.0	IN
14	FS5123	WIRE,BUS,AWG 14,QQ-W-343E	QQW343S14S2B	81348	3.0	IN
15	FS6013	TUBING,TEFLON,AWG 14	TFT-200-14-NAT.	92194	2.0	IN

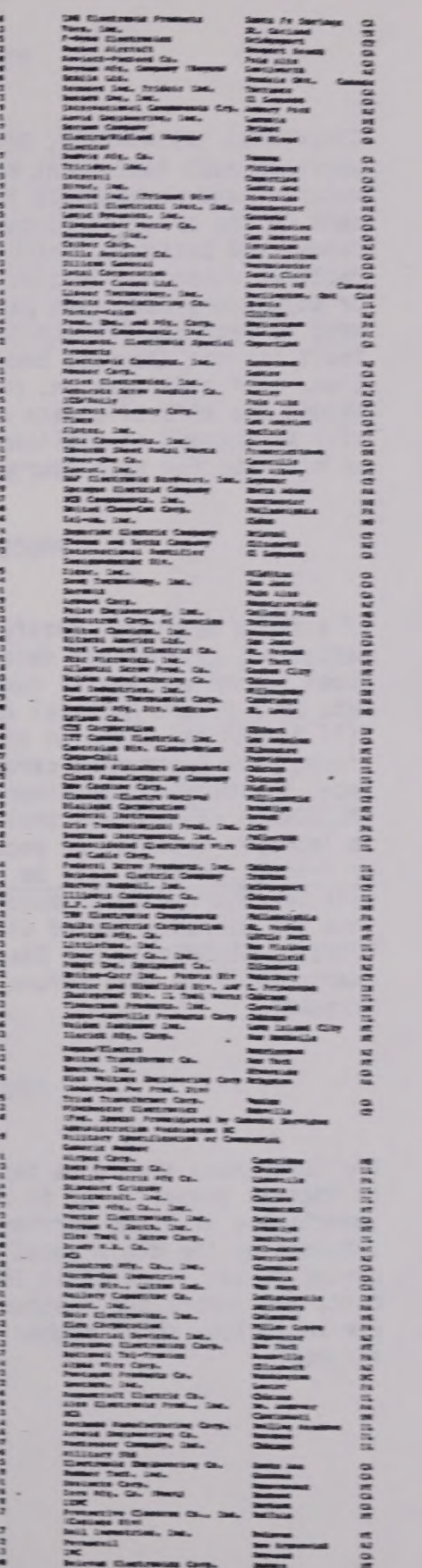
SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
Q1	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q2	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q3	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q4	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q5	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q6	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q7	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q8	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q9	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q10	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q11	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
R1	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R2	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R3	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R4	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R5	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R6	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R7	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R8	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R9	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R10	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
R11	550144	RES,PWR,5W,.2 OHM,5%	RW55GR20WL	63743	1.0	EA
1	4150-764-1	PWB,HEATSINK,OUT DRIVER	4150-764-1	16067	1.0	EA
2	4150-236-1	HEATSINK	4150-236-1	16067	1.0	EA
3	250315	TERMINAL,QCK CLP,PB,MALE	836	79963	2.0	EA
4	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	2.0	EA
5	FS1034	SCREW,PNH,S/S,6-32X5/8	MS51957-31	96906	11.0	EA
6	FS1026	SCREW,PNH,S/S,6-32X1/4	MS51957-26	96906	11.0	EA
7	FS1074	WASHER,SPLT,S/S,#8	MS35338-137	96906	2.0	EA
8	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	22.0	EA
9	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	2.0	EA
10	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	11.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
12	FS4012	CONDUCTING LUBE	PS8 PENETROX A	09922	.1	OZ

APPENDIX B

```
1 CLEAR
2 DISP ;"24HR STABILITY TEST IN PROGRESS"
4 DISP ;"DO NOT TOUCH ANY COMPUTER CONTROLS"
10 PRINTER IS 701
15 PRINT ""
20 RESET 7
30 REMOTE 702
40 LOCAL LOCKOUT 7
50 CLEAR 7
55 OUTPUT 704 ;"F1R0X"
60 OUTPUT 702 ;"FNC ACS :CH0 SET CURL100 SET FREQ400 SET VOLT140"
65 OUTPUT 702 ;CLS :CH0"
70 PRINT USING "10A,4X,3A,4X,3A,4X,12A," ; "ELAPSED HR","OUT",
"OSC","%GAIN CHANGE"
80 IMAGE 7X,2D,4X,3D.3D,3X,D.3D,6X,3Z.5D
90 ! ESTABLISH INITIAL GAIN(I)
100 GOSUB 1000
110 I=G
120 PRINT USING 80 ; 0,V,O,0
130 FOR H=1 TO 24
140 FOR M=1 TO 3
150 WAIT 1200000
160 NEXT M
170 GOSUB 1000
180 C=(G-I)/I*100
190 PRINT USING 80 ; H,V,O,C
200 NEXT H
210 CLEAR 7
215 LOCAL 7
220 END
1000 ! MEASURE & SCAN SUBROUTINE
1005 OUTPUT 708 ;"RX"
1010 OUTPUT 708 ;"B1C1X"
1020 WAIT 2500
1030 ENTER 704 ; V$
1040 O=VAL (V$[6])
1050 OUTPUT 708 ;"RX"
1055 WAIT 50
1060 OUTPUT 708 ;"B2C2X"
1070 WAIT 2500
1080 ENTER 704 ; V$
1090 V=VAL (V$[6])
1100 OUTPUT 708 ;"RX"
1110 G=V/O
1120 RETURN
```

Appendix A





ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS, Division of Amstar Technical Products Co., Inc., warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or a Return Material Authorization (RMA) number will be given. Fill in RMA No. blank on shipping label attached opposite these instructions, pack instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No., or freight collect will be refused. Instruments repaired under Warranty will be returned by prepaid surface freight. Instruments repaired outside the Warranty period will be returned freight collect, F.O.B. CALIFORNIA INSTRUMENTS, San Diego, CA. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. A full report of the damage should be obtained by the claim agent, and a copy of this report should be forwarded to us. CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost, and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.

From

Amstar
Electronics Group

California Instruments Corporation

5150 Convoy Street
San Diego, California 92111

Attn: Customer Service

RMA NO. _____

MP MASTER
MA28314